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A

COURSE

OF

Anatomico-Physiological

LECTURES

ON THE

HUMAN STRUCTURE

AND

ANIMAL OECONOMY;

Interspersed with

Various Critical NOTES, extracted from Memoirs, Transactions of Learned SOCIETIES, &c. and Pathological Observations deduced from the Dissection of morbid Bodies.

INCLUDING

Whatever is most valuable in the WORKS of all the eminent PROFESSORS on these Subjects.

PARTICULARLY

WINSLOW, HALLER, RUYSCH, MORGAGN, MONRO, HEISTER.

Illustrated with

An HISTORICAL COMPENDIUM of the Rise, Progress, and Discoveries, which have been made in the ANIMAL OECONOMY, gradually traced to the present Time.

To which are prefixed,

TWO ESSAYS on the ARTS of Dissecting, Injecting and Making ANATOMICAL PREPARATIONS.

VOL. II.

Omne tulit punctum, qui miscuit utile dulci. HOR.

By CHARLES NICHOLAS JENTY, M.A.
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AN INTRODUCTORY LECTURE.

Of the SECRETIONS.

BELOW each of the first salival Glands, or Parotides, toward the mastoïd Apophysis, is fixed a small one of another Kind, differing from the former in Figure, Colour, excretory Duct, and in the Fluid, which it secretes. It is round, and of an even Surface, without Tubercles, and it is the superior of a great Number of Glands of the same Kind, which lie partly below the Interstice between the parotid and maxillary Glands and at different Distances, along the internal jugular Vein, all the Way to the inferior Part of the Neck. We observe among the Glands and upon this Vein a great Number of transparent Vessels, with an Appearance of numerous Valves. The Fluid which they contain is transparent, a little mucilaginous, and is called Lympha.

These Vessels and Glands are likewise termed lymphatic. The Glands are not all equally large, our equally round, some being oblong, thick, flat, small, &c. The lymphatic

ſels go out alternately by one Extremity, from one Gland, and enter by the other Extremity into ſome other near the former, and both as they go out and as they enter, theſe Extremities are very much ramified. The Trunk is commonly ſingle, and the Valves are ſo diſpoſed, as that the Fluid contained in the Veſſel can only run toward the Thorax, but cannot return to the Head.

Theſe Glands and Veſſels are found in many other Parts of the Body. We meet with them not only in ſeveral Parts of the Head, but alſo in many external and internal Parts of the Thorax, Abdomen, and both Extremities. They accompany the maxillary ſalival Glands, as well as the Parotides; and there are ſeveral ſpread on the lateral and poſterior Sides of the Neck, in the Membrana Adipoſa, near the Muſcles.

In the Cavity of the Thorax the lymphatic Glands are ſituated at different Diſtances on one Side and behind the Oeſophagus, eſpecially at the Place which is even with the fifth dorſal Vertebra. I have found ſome on the anterior Portion of the Diaphragm on one Side of the Mediaſtinum; and there are others round the Baſis of the Heart, in the Fat which lies there. They are to be met with likewiſe in the Subſtance of the Membrana Adipoſa which covers the Thorax, near the inner Surface, eſpecially about the Clavicles, and in the cellular Interſtices of the Muſcles which lie on the Thorax.

In the Cavity of the Abdomen theſe Glands are very numerous, and particularly round the ſuperior Orifice, and on the two Curvatures of the Stomach; on the Capſula of the Sinus of the Vena Portæ; on the cellular Ligament of the Veſicula Fellis; near the Beginning of the Ductus Cyſticus; at the Adheſions of the Omentum to the Spleen,

and to the Colon; through the whole Extent of the Meſentery; at the Adheſions of the Meſo-colon; behind the Adheſions of theſe two Membranes to the Vertebræ of the Loins; near the Bifurcation of the Aorta; and along the Iliac Veſſels*. There are likewiſe other ſuch Glands on the Outſide of the Abdomen, in the Subſtance, and toward the Inſide of the Membrana Adiposa.

In the ſuperior Extremities of the Body, theſe Glands lie chiefly under the Articulation of the Os Humeri with the Scapula, in the Cavity of the Axilla. The moſt conſiderable lymphatic Glands in the inferior Extremity are toward the lower Part of the Inguina, commonly called the inguinal Glands, to which the Faſcia Lata or Crural Aponeuroſis gives a Kind of double Capſula, which makes ſome of them lie very near the Skin, and the reſt at a greater Diſtance from it†.

There are three Sorts of Veſſels that now go by the Name of Lymphatics, whereas formerly that Word was uſed only to ſignify the tranſparent Veſ-

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* If we tie a Pipe into the Subſtance of the iliac lymphatic Glands, and ſecure the Orifice of the thoracic Duct near the left ſubclavian Vein and pour Quickſilver into the Pipe, we fill not only the firſt and ſecond lateral Veins with all the Glands of the Meſſentery, but likewiſe find ſometimes a fine fluid Injection will ſucceed, as I did about ſix Years ago in a Child about three Years old.

† As all theſe lymphatic Glands differ more in Situation, than in Size or Figure, they are commonly enumerated and denominated from the Places already mentioned, where they lie in the following Order. GLANDULÆ PAROTIDES LYMPHATICÆ, GLANDULÆ MAXILLARES LYMPHATICÆ, GLANDULÆ JUGULARES, GLANDULÆ CERVICALES, GLANDULÆ OCCIPITALES, GLANDULÆ CLAVICULARES, GLANDULÆ AXILLARES, GLANDULÆ THORACICÆ, GLANDULÆ OESOPHAGÆÆ, GLANDULÆ MEDIASTINÆ, GLANDULÆ CARDIACÆ, GLANDULÆ VENTRALES, EXTERNÆ, INTERNÆ, GLANDULÆ STOMACHICÆ, GLANDULÆ HEPATICÆ, GLANDULÆ CYSTICÆ, GLANDULÆ EPIPLOÏCÆ, GLANDULÆ MESENTERICÆ, GLANDULÆ LUMBARES, GLANDULÆ ILIACÆ, GLANDULÆ INGUINALES, GLANDULÆ CRURALES, &c.

ſels already mentioned, which accompany the lymphatic Glands. The original Sources of theſe Veſſels are very difficult to be found out; and even their Diſtribution through the Body has not been ſufficiently traced to enable us to deſcribe them particularly in this Treatiſe, and therefore I muſt reſerve that for the Subject of another. As to their Termination, we are ſure that for the moſt Part they end in the Ductus Thoracicus.

Beſides theſe Veſſels which accompany the Glands, there are others of the ſame Structure found on the ſeveral Viſcera, where no lymphatic Glands have hitherto been diſcovered. We meet with them in very great Numbers in the external Membrane of the Liver, and in the Duplicature of the ſuperior membranous Ligament of this Viſcus, as ſhall be obſerved. Several Diſcoveries have been made about theſe Veſſels in Brutes, which I here paſs over in Silence, the ſole Deſign of this Lecture being to deſcribe thoſe of the human Body.

The third Sort of Veſſels termed Lymphatics, are the ſmall Arteries and Veins which in the natural State, tranſmit only the ſerous Part of the Blood. Theſe Veſſels differ from thoſe of the firſt in the Smalneſs of their Diameter, and in their Structure and Situation. All theſe little Arteries and Veins are uniform, extremely narrow, and though their Sides are not thinner than thoſe of the valvular Lymphatics, yet their Diameters are generally leſs. The other Lymphatics are full of Valves, and very thin, but they are not narrow in Proportion. The arterial and venal Lymphatics are found on the Parts which are naturally white, as on the Skin, the White of the Eye, &c. and their Origins are eaſily diſcoverable; but the valvular

vular Lymphatics are confined to the internal Parts of the Body, and are found on Parts of all Colours that are in the Body, and we cannot eaſily trace them to their original Sources*.

The Claſſes or Tribes of Humours, which, being depoſited or ſtrained off from the Blood into other Veſſels, are ſaid to be ſecerned or ſecreted, ſeem reducible to four; of which the firſt includes all the viſcid and lymphatic Juices, which, by Fire or Alcohol Vini, turn into a hard Coagulum, although generally in the living Animal, they are capable of flying off in Form of a Vapour, and after Death are within the ſame Veſſels compacted into a gelatinous Thickneſs. To this Claſs belong the vapourous Juices of the Ventricles of the Brain, of the Pericardium, Pleura, Peritonæum, vaginal Tunic of the Teſticle, of the Amnios, Joints, and probably of the Womb, with the Juice of the Stomach and Inteſtines, of the renal Capſules, and laſtly the Lymph itſelf commonly known and called by that Name.

The ſecond Claſs is of thoſe Juices, which are ſome of them exhalable like the former, but being more ſimple and aqueous, are neither to be coagulated by Fire, nor by rectified Spirits of Wine; and others of which do not exhale, but being depoſited in their reſpective excretory Ducts, are expelled by ſome common Outlet, proper to a Part of

* I think it very proper that the ancient Diviſion of Glands into conglobate and conglomerate ſhould be retained. Under the firſt Kind I include the lymphatic Glands alone, and all the other Glands of the Body under the ſecond; and theſe again may be ſubdivided into ſimple and compound. I muſt be obliged to refer what ſtill remains to be ſaid concerning the internal Structure of Glands and glandular Bodies to a particluar Diſſertation, which is deſigned to contain an Anſwer to HELVETIUS's Letter publiſhed at the End of his late Performance concerning the Pulmonary Blood. WINSLOW.

ſome Gland. To the former of this Claſs belong the perſpirable Matter of SANCTORIUS, and probably the internal perſpirable Matter of the Epithelium and cellular Subſtance, with Part of the Tears and watery Humours of the Eye. To the latter of this Claſs belong the remaining Part of the Tears, the Saliva and pancreatic Juice, that of the renal Capſules, and the Urine. The Sweat ſeems to be a Mixture of the perſpirable Matter, and ſubcutaneous Oil.

The third Claſs differing from both the preceding, includes the viſcid ſluggiſh or filamentous Juices; but ſuch as are of a watery Diſpoſition and not congealable into a Jelly, but hardening into a Cruſt-like, or ſcaly Subſtance, by exhaling their Water. Of this Sort are all the Kinds of Mucus in the human Body, ſpread through all the internal Paſſages for Air, Aliments, or Urine, the Cavities of the genital Parts, Liquor of the Proſtates and Semen, to which add the black Humour of the Uvea in the Eye.

The fourth and laſt Claſs is that of the inflammable Juices, which, at their firſt Formation, are indeed thin and watery, but, by Time, ſtagnating and exhaling their more watery Parts, become a thick, oily, inflammable Liniment often very bitter. To this Claſs, we refer the Bile, Ear-wax, ſebaceous and oily Liniment of the Skin, the Marrow, and all the Fat of whatever Conſiſtence or in whatever Part ſeated throughout the human Body and the Milk itſelf, ſo far as it is butyraceous and inflammable.

Thoſe who conſider, that in the Blood are found a coagulating Serum, an exhaling Water, a Sort of viſcid Mucus, and laſtly, a thick and thin Oil, may thence begin to perceive the Poſſibility of a

Separation

Separation to be made from the Blood of all the foregoing Classes of Humours; in as much as we thus see their constituent Principles are already in the Mass of Blood itself. But in what Manner it is brought about, that Oil is separated from the Blood in one Part, an aqueous Liquor in another, or a gummy Mucus in a third, is a Task that still remains to be explained, and requires a previous Knowledge of the secretory Organs themselves.

The albuminous or hardening Juices are separated almost every where from the Arteries themselves, into continuous excretory Canals, without any intermediate Organ or Machine betwixt them. The Proof of this we have from Injections of Fish-glue, Water, and thin Oils, which very readily pass the red Arteries, and are poured out like unto Sweat into all the Cavities of the Body, in which we naturally find the said serous Vapours in Form of a coagulable Water, nor do the Injections in this Course meet with any intermediate Obstructions from any hollow Cavities and Cells. Finally, the Blood itself, being so readily poured out into most of these Cavities, without any permanent Damage, when its Course is either much obstructed, retarded, or urged with a greater Impetus through the Arteries, shows plainly that there is a short and open Way betwixt the red Blood Vessels and those excretory Ducts; (whence the yellow Serum differs not much from the Cruor.)

Among these Juices we reckon the venal Lymph, mentioned before, which passes through the valvular pellucid Vessels to the thoracic Duct. For this seems to be drawn off immediately from the Arteries, if we give any Credit to the numerous Experiments of great Anatomists, which show that the red Blood, Mercury, and other Liquors pass

from the ſanguineous Arteries directly into the valvular lymphatic Veins themſelves. The Credit, both of this Fact and the Experiments, is alſo further confirmed by the Mixture of Redneſs and Yellowneſs, often obſervable in the Lymph itſelf; and which, by the Microſcope, is a Demonſtration of the red ſanguineous, and yellow ſerous Globules, which paſs and float in the Lymph.

It muſt not indeed be denied, that theſe lymphatic Veſſels have a ſort of peculiar Glands to themſelves, into which the ſaid Lymphatics depoſit their contained Juice, and then convey it away from it again. But then the lymphatic Veſſels do not ariſe in theſe Glands, with which they only communicate in their Paſſage. For, they ariſe viſibly enough upon the Surface of the Lungs, Liver, and Inteſtines, and run on for a conſiderable Length before they enter thoſe Glands.

Theſe Glands then ſeem to contribute ſomething peculiar to the Lymph and Chyle in their Courſe, more than has hitherto been well diſcovered. The Structure of them here follows. They appear, as they are called, conglobate, or of an oblong, Olive-like Figure, ſometimes ſolitary, but often in Cluſters, and looſely inveſted in the cellular Subſtance, in which they enjoy a Sort of free Liberty, or floating Motion, in moſt of the internal Parts of the human Body, and in many of the external Parts. Among the latter we may reckon thoſe which, ariſing in the Face and ſuperior Part of the parotid Gland, and Angle of the inferior Maxilla, deſcend along the Side of the Neck with the jugular Vein; thence dividing as it were, or receiving a Collection of Glands from the Arm, they paſs on in a direct Courſe with the ſubclavian Vein to the Arm-pit, where they are moſt numerous. Some again are extended as far as the Flexure of the

Cubitus

Cubitus itſelf; but none appear on the reſt of the ſuperior Extremities, nor upon all the Back.

In the Thorax they deſcend in great Numbers with the Trachea Arteria, and along the Sides of the Pericardium, others deſcend anteriorly upon the Vena Cava and Pericardium down to the Diaphragm. The Poſterior Lymphatics are many, encompaſſing the Trachea Arteria on all Sides, and playing round its Ramifications, reach to the Extremities of the Lungs, while thoſe in the Poſterior Mediaſtinum ride over the Pericardium, and with the thoracic Duct extend to the Diaphragm.

In the Abdomen laſtly, there are others called the lumbal Lymphatics, which form a conſiderable Collection in the folding of the Groin, whence extending along with the great Blood Veſſels in the Courſe of the ſartorius Muſcles, they vaniſh in the Ham or bending of the Knee. Other Lymphatics paſs from this inguinal Collection into the Pelvis, and continue their Courſe upwards through the cellular Subſtance, behind the Rectum, and along with the large hypogaſtric Veſſels. There are alſo ſmall lymphatic Glands of the ſame Kind, with their reſpective Aſſemblages, ſeated in the greater and leſſer Curvature of the Stomach, and the Origin of the great and little Omentum, at the Entrance of the Porta into the Liver, in the Courſe of the ſplenic Blood Veſſels near the Spleen, and laſtly, thro' the whole Extent of the Meſentery and Meſo-colon.

The common Fabric of theſe lymphatic Glandules is, that they conſiſt of ſtrong, external, ſmooth Membranes, furniſhed with many red Blood Veſſels; within which is a ſoft and lax cellular Subſtance, but of a ſhort Extent, betwixt the Cells of which run numberleſs ſmall ſanguineous and lymphatic Veſ-

ſels,

ſels. As for any Folliculus, or Concavities, muſcular Fibres, or duplicate Membranes, they are to me unknown.

That theſe Glandules are of ſome Uſe to the Lymph and lymphatic Veſſels, is certain enough, ſince we ſee no lacteal or lymphatic Veſſel ever paſſes to its Inſertion, without firſt diſtributing Branches thro' one of theſe Glands, and receiving reductory Branches thence. The chylous Juice with which theſe Glandules are filled in Children and other young Animals, and the Ink-like Juice which they contain in the Breaſts of old People prove that there is ſomething ſeparated from the Blood in theſe Glands, and poured into the Lymph and Chyle, which are here probably expelled into the cellular Spaces of the Gland. Their greater Magnitude and more perfect Structure in the younger Animals, with the ſhrinking and Corruption or Deſtruction of them in Adults, and old People, perſuade us, that this their Secretion is more perfectly made in the younger Animals, and that it periſhes in the older. And no Part is oftener ſchirrous than theſe; whence it is not probable, that the Lymph is in them accelerated. The Thymus is of the conglobate Kind of theſe Glandules, but divided into Lobules; there are found alſo in the Groins, Arm-pits, and other Parts, conglobate Glandules of this Sort, collected into Cluſters.

Another coagulating Juice, which hardens likewiſe by mineral Acids and Alcohol, is the albuminous Humour of the Joints, which, mixed with ſome Fat and medullary Oil, makes a moſt ſoft or ſmooth Liniment, to lubricate the Heads of the Bones and leſſen the Friction of the Articulations. For the Separation of this Liniment, certain conglomerate Glandules of a peculiar Fabric are aſſigned, which

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are usually so placed in the rough Sinuosities of the Joints, that they suffer a moderate Compressure, increasing their Discharge, without bruising by the Motion.

These mucilaginous Glandules have a peculiar Fabric. The larger of them rest upon the Bones with a broad Basis, from whence they are gradually extenuated or acuminated into a Ridge, from the thinnest Margin in which they deposit their Juice by open Ducts. They have a good deal of Fat intermixed, and are manifestly composed of lesser Bunches. Others still smaller are scattered about the vaginal Capsules of the Tendons, and betwixt the dividing Fibres of the Tendons, which last seem to be almost of the Nature of simple Glandules, turgid with a yellow mucous Serum.

The uncoagulable Juices of the first Sort are secreted in the same Manner with those which harden, to wit, from the exhaling Arteries, which arise from the red sanguineous Arteries, without any intermediate Follicle or Cavity betwixt them. Thus the Vessels, which pour out the perspirable Matter through the Skin and lacrymal Ducts of the first Sorts suffer a watery thin gluey Injection to transude so readily from the Arteries, as leaves no Room to doubt of this Truth. (And these secretory Ducts have also a considerable Degree of Irritability; whence by any Stimulus or Contact of acrid Particles, they discharge more Juice in a given Time, than what they distil in a State of Health.)

But in the latter salival Kind, of that Class, the Secretion is made by Means of conglomerate Glandules, which the Ancients so called from their Cluster-like Fabric, and esteemed them almost the only proper Glands. These are composed of roundish Lobules or Clusters (somewhat like those in Bunches of Grapes, Currants, Barberries, &c.)

loosely

looſely conjoined together into large Maſſes by the yielding cellular Subſtance, which, at laſt, often forms a denſer Tunic or Covering to the whole, like as we ſee in the parotid and maxillary Glandules. Through the Interval, betwixt theſe glandular Cluſters run the Arteries and Veins, which are here large or conſiderable enough, but moſt of the conglomerate Glandules ſeparate their Juices in ſuch a Manner, from the Blood, and from thence diſcharge it ſo, that each cluſtery Portion ſends out an excretory Duct, which, joining with the others of the ſame Kind, form larger Trunks, which at laſt, in the Manner of a Vein, end in one Canal, which conveys the Humour ſeparated by the Gland, to the Part for which it is deſigned, as the Cavity of the Mouth, Inteſtines, Surface of the Eyes, &c. There are indeed, ſome of theſe Glands in which the ſaid excretory Ducts are either not preſent, or at leaſt, not yet diſcovered; as we obſerve in the thyroïd Glandules, thoſe called Capſulæ Renales, the Thymus, and the pituitary Glandules.

The Acini or Kernels of theſe conglomerate Glands are each of them circumſcribed and limited by a harder Stratum of the cellular Subſtance; by which Subſtance they are alſo ſubdivided into leſſer Acinuli, as is evident to the Eye and by the Microſcope. But it may be queſtioned, how does this Subdiviſion end, whether or no is every ſimple Acinus hollow in the Middle, that, by receiving the Humour tranſuding from the Arteries into the Follicle or Cell it may be ſent out thence by the excretory Duct; whether or no we are perſuaded to believe ſuch a Fabric obtains from the ſmall Shot-like Stones and Hydatides bred in theſe Glands, with the round Scirrhi that ſometimes fill the Kidneys? whether in this Opinion made probable

bable by the morbid round Concretions formed in the Liver, Spleen, Kidneys, Teſticles, and Cortex of the Brain? or from the Bunch-like Diviſion or Appearance, which thoſe Viſcera have in younger Animals? whether the cellular Subſtance that ſurrounds the extreme Vaſcules in all Parts, does not communicate by open Areolæ, or Cells, in a ſecreted Humour is poured by theſe Glandules? In ſhort none of theſe Arguments appear true or concluſive. For the Acini, which are found in the Viſcera of Animals, are component Lobules and not elementary Parts, but are large and compounded for the Conveniency of each Beaſt. The morbid Concretions are almoſt all of them a Sort of Placentulæ, and take up their Seat even in the Limbs themſelves where there is not the leaſt Room to ſuſpect any Thing of the glandular Fabric, and are compoſed, as to their Matter, of Oil, Earth, and vapourous Particles, extravaſated into ſome of the Inteſtines of the cellular Subſtance, where, ſtagnating and compreſſing the adjacent Follicles, they form to themſelves proper membranous Tunics. On the contrary, the watery and fluid Nature of the Juice ſecreted in theſe Glands, are Arguments that it meets with no Obſtruction in the Separation, nor Places of Stagnation in its Way. For all the Juices, which reſt any Time in the warm Cavities of the human Body, which are full of abſorbing Veſſels, are each of them more or leſs inſpiſſated, and approach either towards a Mucus or an oleaginous Diſpoſition. Moreover, if there were any ſuch Arreſtments, anatomical Injections would meet with more Difficulty in paſſing from the Arteries into the excretory Ducts of thoſe Glands; which, under ſuch Circumſtances, would be impervious to thick Injections, and thin ones they would exhale into their cellular Fabric.

Yet we see that the superlative Art of great Anatomists has not only conveyed Injections, but even thick ones like Wax, directly from the Arteries of the salival Glands, Liver, &c. into their excretory Ducts, and this without filling up any intermediate Knot-like Cavities, which, according to the foregoing Hypothesis, they ought to exhibit.

Therefore the Acini of these Glandules appear composed merely of Arteries and Veins (which last include excretory Ducts) divided and subdivided, parted and connected by the Intervention of a good deal of cellular Substance, whose Strata, growing gradually more compact or firm as they enlarge, at length show their Contents moulding into a sort of globular Nut-like Figure. In the Belief of this, we are confirmd by Analogy, in the Lobes of the Lungs, the Lobules of the Thymus, and from the Structure of Insects, but more especially the Fabric of the Testicle, in which we plainly see that Lobules are formed of excretory Ducts, connected in Fasciculi by a very soft cellular Membrane. But they seem not to pour their Juices into a cellular Fabric, which would intercept or make difficult, the Passage to an excretory Duct.

Thin watery Juices, neither coagulating nor wholly evaporating, are likewise in other Parts generated without the Assistance of conglomerate or kernelly Glandules. For thus the Urine is deposited from the red and sanguineous Arteries into membranous Parts, with which they are manifestly continuous and form an easy Way, admitting Air, Water, and Mercury to pass in like Manner. And after the same Manner, tho' less evidently, the nervous Juice seems to be separated in the Brain.

The third Class of mucous Juices are indeed almost every where separated into, and discharged from

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the Sinus of hollow Glands. Theſe true Glands or Follicles have, in general, ſuch a Fabric as makes up an ample Cavity, every Way circumſcribed by a Membrane; but in ſuch a Manner, that the Fleſh itſelf of the Part, to which the Gland adheres, is often taken for another cloſe Hemiſphere of the Follicle. The ſaid Cavity or Follicle is for the Generality round, but ſometimes it is oblong, and obliquely creeping betwixt the adjacent Parts, as for Example in the Urethra of the Male, and in the Follicles of the Female Sinus.

Into theſe Follicles or Cells, the leaſt Arteries (or the vaſcular Fleſh ſurrounding each Crypta or Cell, and compleating its Convexity) open by producted Extremities within the Cavity of each Crypta, into which they diſtil or exhale their reſpective Juice, where, being retained from the Narrowneſs of the excretory Ducts, the more watery Parts are drawn up by the abſorbing Veins, which correſpond to, and reſemble the exhaling Arteries, and thus the follicular or cryptal Juices receive a conſiderable Degree of Thickneſs. The Truth of this we are taught from the Structure of the ſimple Follicles, obſervable in the Tongue, in which both the importing arterial Ducts or Pores, and likewiſe the excretory Orifice, are viſible to the Eye; and from the Veſſel-like Tubuli lining the Stomach of Birds, Quadrupedes; and Mankind in each of which an importing ſmall Artery, a reductory Vein, and an excretory Canal, appears to open pendulous in the Cavity; and laſtly, from Injections, which diſcharge a colourleſs Wax into the ſimple Glands.

Whether the mucous Cavity of ſuch a Glandule be long or round, it has always an excretory Duct, which, for the moſt part, is none of the leaſt; altho' in the round mucous Glandules, the diſcharging Duct or Orifice be leſs, in Reſpect to the

reſerving

reſerving Cavity, than in others. This diſcharging Orifice often opens into the common large Cavity, into which the Mucus is to be poured, without any intermediate Duct, for thus it is in the Back of the Tongue, and in the ſimple Glands of the Stomach and Inteſtines, where they have been demonſtrated Cryptæ or Cells by RUYSCH. The Sinuſes have often the like Fabric, opening without an intervening Duct, as in the Urethra of the Male.

Another Kind of theſe mucous Glandules are thoſe which we commonly call conglutinated; where many ſimple Follicles are folded up together in one common Covering, and open with their gaping Orifices into one common Sinus, without forming any true excretory Duct. This Fabric we obſerve in the Tonſils.

Other ſimple Glands of this Claſs have an excretory Duct, by which they expel their Mucus, namely, a narrow, membranous, cylindric, ſmall Veſſel, opening with its poſterior Orifice into the Cavity of the Glandule, and with its anterior Orifice into the common Cavity, for which its Mucus is deſigned. Theſe excretory Ducts are of conſiderable Length in the ſubcutaneous and ſebaceous Glands, and in thoſe of the Palate and Wind-pipe. In ſome Parts alſo, the Pore or Orifice, and its Duct, are more eaſily demonſtrable, than the Follicle or Body of the Gland itſelf as in the Noſtrils, Larynx, Rectum, &c.

In others again, an Aſſemblage of theſe Ducts, ariſing each from its reſpective Follicle, run together into one like the Branches of a Vein, ſo as to form a conſiderable excretory Canal, common to a Number of Follicles. To this Kind belong the compound mucous Glands of the Inteſtines, ſome of the larger in the Cavity of the Urethra, with the blind or impervious Duct or Sinus at the

Root of the Tongue, to which, in Brutes and Birds, add the Fringe-like Tubuli of the Stomach. The Glands of this Sort may be called ſimple ones compounded or continuous; but where they lie only contiguous one to another, they may be called ſimple aggregate or congregated Glandules; as are thoſe of the Fauces, Stomach, Inteſtines, &c.

The inflammable Juices are ſeparated by Organs differing in their Fabric. The Fat and Marrow are depoſited without the Intervention of Glands, from the ſmall Mouths of the leaſt Arteries into the cellular Coats or rather Subſtance; and the ſame Fat again eſcapes from under the Skin by ſmall Pores or Ducts, without the Aſſiſtance of any glandular Follicles. But the Ear-wax, and the waxen or ſweaty Liniment of the Skin, are ſeparated by Glands of divers Kinds. Moſt of the ſebaceous Glandules are viſible enough, with an open or naked Mouth in the Skin, that leads immediately into the Follicle, without any Duct of conſiderable Length, as we ſee in the external Ear, Noſe, Rings about the Nipples, in the female Nymphæ, and the Valley or Grove that runs betwixt them and the external Labia, in the Clitoris and male Glans Prepuce. Theſe differ but little from the Crypta, except in their contained Matter, which they ſeparate.

There are others of the ſebaceous Glands, which have an excretory Duct of a conſiderable Length, like moſt of thoſe in the Skin, which, being ſeated in the cellular Subſtance, have conſequently a Duct long enough to perforate the Skin. Thus we ſee, it is in the Face more evidently, where the Length of the Duct is often to be meaſured by the concreted Maggot-like Subſtance preſſed out, that a Follicle or Cell lies under the narrower Pore.

There are ſtill other ſebaceous Glands of the continuous or conglomerate Kind, in which many Cryptæ by ſmall Ducts meet together in one larger excretory Duct. Thus in the Face, in ſeveral Places, where there are large Pores in common to a Number of ſubjacent Cryptæ. And of this Kind are thoſe ſebaceous Sinks in the Eyelids; and thus it is in the Organ which ſeparates the ſebaceous Perfume, in the ſebaceous Glandules of the Muſk-goat of *America*.

The Milk being a Humour of its own particular Kind, formed of Oil and watery Juices intermixed, is ſeparated by conglomerate Glandules. Whether the Secretion of the Bile be glandular, is controverted; but there are many Arguments to perſuade us, that the Liver is a mere vaſcular Fabric, whence the Bile diſtils immediately from the Extremities of the Porta into the Pori Biliarii or Origins of the biliary Ducts, without paſſing any Cells or Follicles by the Way; and in this we are more eſpecially confirmed by the Ruyſchian Art of Injection, in which the Wax paſſes directly from the Porta into the biliary Ducts, without exhibiting any intermediate Stoppages; and therefore we ſee the Milk and Bile are both of them much thinner and more watery than the Fat, or the ſebaceous Matter which thickens in Follicles.

It now remains for us to inquire, how from one common Maſs of the Blood, the ſame Variety of peculiar Juices are conſtantly ſeparated each in their reſpective Places, ſo that we never ſee Milk ſecreted in the Kidneys, Bile in the Thymus, or Mucus in the ſebaceous Glands. This Problem, indeed may be ſolved by one, who ſhall have previouſly acquired a thorough Knowledge of the intrinſic Fabric, that obtains in each ſecretory Organ. In the mean Time, we ſhall here propoſe, what

what has been hitherto advanced with Certainty on that Subject from any known Principles, whose Truth we are convinced of.

And first, the Blood itself, from whence the Humour is to be secreted, undergoes a Sort of hydraulic Preparation in the various Parts, by which it puts on such a Character or Disposition, there peculiar to itself, that more Particles of a like Nature with the Humour abound in that Blood, which Nature intends to separate from it. In the Liver, the venal Blood, with a very slow Motion, full of Oil, and full of the semiputrid Vapours of the Intestines. At the Testicles, the Blood is brought slowly through very long, slender, and inflected Canals, arising at very small Angles, and passing out at the Abdomen through a cold Tract under the Skin. In the Carotids, it is probable that the denser Parts of the Blood ascend, while whatever is more watery descends into the Abdomen and to the Kidneys: Also to the forming of the salival Juice of the Pancreas, Liquors of the Stomach, and Intestines.

Another Preparation of the Blood towards Secretion, is from its Retardation in the least Vessels whereby the red and denser Parts of the Blood go on by themselves along the Axis of the Canal, while the other lighter and more sluggish or viscid and less moving Particles, recede to the lateral Opening or Branches, so as to enter the secretory Orifices, which pass out from the Sides of the said Vessels.

The Passages of these secretory Orifices, tho' of different Diameters, are yet always small enough, in their healthy and natural State, to refuse the red Blood. Hence, therefore, we may conclude, that, being enlarged by an increased Force of the Heart, they every where admit of a good deal of

the red Blood from the ſanguineous Arteries, which they ariſe from, and open into; being in their natural State not much leſs than the red Globules. And hence the ſame ſecretory Orifices or Ducts, which refuſe thick Injections of Wax or Suet do, nevertheleſs, generally admit thinner Liquor injected into the Arteries. Therefore this is the firſt and moſt ſimple Mechaniſm, or Machine of Secretion, viz. that the Opening of the excretory Duct may admit only ſuch Particles as have their great Diameter leſs than the Diameter of the ſaid Opening. From this Reaſon only, it is, that the yellow Arteries convey off a pure Liquor from the Blood, and that the uniferous Ducts exclude both the red Blood and coagulable Serum. But this is not the ſole Cauſe, ſince the ſame Juices are generated by large as by ſmall Animals.

Merely by this Law, (of this ſecreting Orifice) the ſecreted Juices may be of many different Sorts: for thoſe, whoſe Lights or tranſverſe Sections are the leaſt, will receive only the thinneſt Juices, as in the ſmall Veſſels of the Brain; and the larger Ducts will admit Water and Jelly, while the thickeſt Fat will enter the largeſt of all. Moreover, if a Number of ſecretory Organs are formed in a Succeſſion from one ſecreting Artery, each of them having large Mouths or Ducts, in that Caſe, the leaſt, which comes out from the ſaid Artery, will receive only the thinneſt Juices. But if theſe, which are firſt formed in Order from the ſecreting Artery, have ſmaller Ducts, than the laſt only will receive the groſſeſt Juices.

From hence it is, that the Secretions, which are generally made immediately from ſanguineous Arteries, without paſſing the ſeveral lateral ones, are all of groſs Juices, thick, coagulable, or watery, as the Fat, Urine, Juice of the Stomach and In-

teſtines, &c. But the other thinner Juices are ſecreted not from ſanguineous, but from ſmaller pellucid Arteries ariſing from the former. To the ſecerning Mouth, therefore, of theſe laſt not only no red Blood, but no Serum, Fat, or other groſs Juices, can have Admittance. Thus the more thin and pure Humours are ſeparated of conſequence; as for Example, in the Eyes, Cortext of the Brain, &c.

Some Share of the Secretion ought, perhaps, to be allowed to the Angle, which the ſecretory Branch intercepts with its Trunk. For it is eaſily demonſtrated, that at right and retrograde Angles, only the viſcid, and ſluggiſh Juices are expelled by the ſtronger Force of the denſer Particles which hold on their Courſe along the Middle of the Artery; whilſt the Denſer go off at half right Angles. For thoſe who have made the trueſt Obſervations on living Animals, have ſeen, that the Velocity of the Blood is greateſt in Veſſels of the acuteſt Angles, and leſs in thoſe of right Angles. That the Effect of theſe Angles in the Veſſels is conſiderable, with regard to the Secretion, we are perſuaded from the Structure in ſeveral Parts of the Body, ſince they form different Angles in different Parts, with Reſpect to their Trunks; and in ſome Parts compoſe Net-work. For the ſmall Veſſels in general reſemble the Branchings of little Trees or Shrubs, the Trunks and Arms of them every way ſending out ſmaller Branches, but in different Angles, at ſmall Angles, for Inſtance, the large Inteſtines, and at larger Angles in the ſmaller Inteſtines. Thus in the Spleen, the ſmall red Arteries ariſe thick from their Trunks, that they reſemble a Wiſk or Sprinkler; in the Inteſtines, they reſemble Pencil Bruſhes, vermicular Arches in the Kidneys, Stars in the Liver, and a radiated Circle in

the Uvea, and in the Teſticle, a Lock of Hair curled up into a Button. But we deſervedly receive it as a Rule, that the Creator never made this Diverſity of Fabric without its proper Uſe and Effects.

And the Inflexions of the ſmaller Veſſels greatly retard the Motion of the Blood, in which, therefore, the greater Part of the Force received from the Heart, is evidently ſpent in changing the Figure of the Veſſels. The repeated Inflexions, therefore, of the ſecretory Arteries increaſe the Viſcidity of the Juice by delaying the Flux, and giving the Parts more Time to cohere or attract each other. But a ſtrait Courſe of the Veſſels increaſes the Celerity of their Fluid, whence a copious and eaſy Secretion more uniform or impure, as we ſee in the Urine.

That the ſmaller Arteries have different Degrees of Denſity or Firmneſs, there is no Reaſon to doubt; ſince we actually find it ſo by Experiments in the larger Branches. But the denſer the capillary Arteries, the more they reſiſt the light and ſlowly moving Particles, and yield only to the more denſe ones, that have a greater Impetus.

And, laſtly the Velocity is greatly increaſed, when the excretory Duct ariſes a good deal before the Extremity of a larger arterial Branch that ends with a ſhort Courſe; and is equally diminiſhed, when the ſmall ſecretory Artery runs a long way capillary and cylindrical, whereby the Blood loſes the greater Part of its Motion in Friction. Finally, from whatever Cauſe the Diverſity of the Blood's Motion may ariſe, a greater Velocity of it cauſes the ſecreted Juices to be more denſe or heavy, more groſs and un-uniform or impure; but Slowneſs of its Motion increaſes the Attraction and Viſcidity, and probably renders the ſecreted Juice more pure and homogeneous, as the ſimilar Particles,

ticles, thus ſorted and brought together, can better attract and join each other under a ſlow Motion, ſo as to retain the larger Canal while the thinner Parts go off by the leſſer lateral Branches. From hence it is, that only the Impulſe of the Heart being too much increaſed, all the Secretions are confuſed.

From all that has been hitherto advanced, we may now begin to perceive, that, ſince the Blood contains Particles, of various Kinds, ſome ſluggiſh or filamentary, others mucous, others coagulable; ſome again very fluid, others more denſe and red, ſome glutinous, ſome watery and thin, others fat and groſs: Among all theſe Particles, thoſe which are the largeſt and moſt denſe, as the red and yellow Globules will go on moſt towards the Axis of the Veſſel, ſo as to paſs on in a continued Courſe from the Artery into the Trunk of the ſanguineous Vein.

Thoſe Particles, which are ramous, groſs, and ſluggiſh, as the Fat, muſt needs go off laterally by larger Orifices from the ſanguineous Artery, by ſhort Ducts; for long ones would make a Stop to ſo ſluggiſh a Juice as the Fat or Oil. Therefore we ſee, that the Circumſtances or Rhœnomena of the Adipoſe Secretion, agree with this Deſcription. Such Parts as are coagulable, but ſpecifically heavier than thoſe which are merely watery kept fluid only while the Powers of Life are in Action; theſe paſs off laterally from the ſanguineous, into the pellucid Arteries leſs than the red Arteries, with which they are continuous; whether theſe pellucid ones are continued on in the Nature of Trunks, ſending off other ſmaller Branches like the leaſt Arteries; or whether they exhale their Contents by a ſhort Extremity.

Thin watery Juices may evidently pass off by any Vessels continuous with the sanguineous ones or the lesser ones provided they be only small enough to refuse the grosser Juices: And this, whether they come out from the Sides of the larger Arteries, or whether by a long continued Course; and sending off all the grosser Juices by large lateral Branches, they at length, end in a smaller pellucid Canal instead of a Trunk, like that which supplies the clear Contents of the Eye. To the Production of the Juices, the more simple Fabric is sufficient: Even a direct Continuation of the secretory Artery itself into an excretory Duct, as we see in the Urine. Therefore the Ducts and Vessels have here a strait and simple Course, with few or no Inflections, and a proportionable Velocity or Celerity, as yet holds in the Course of their contained Juices.

Such Juices, as being watery, light, mucous, and viscid at the same Time, are consequently sluggish and less moveable; these may be easily secreted by short narrow Ducts of a less Diameter than to admit the Fat, and appended to the sanguineous Arteries; and therefore, it is evident, these will be separated from the Blood more abundantly in some Parts of the Body than others, namely where the Velocity, received from the Heart's Impulse, is less, the Flexures of the Artery more frequent, and where the Extent of the capillary shall be carried to a greater Length.

Whether or no ought we to ascribe to each particular Part the Ferments, Pores, specific Weights, or Filters, which determine the Nature of the Humour to be a generated one, who admits of these, ought to consider the great Difference there is in one and the same Juice, separated in the same Part of the Body, according to the Difference

ence of Age, Courſe of Life, &c. The Bile in a Fœtus is generated ſweet, the Semen thin and without Vermicules, the Milk either none, or very watery, the Urine watery, mucous, and inſipid, the Uterine Mucus very white, the cutaneous Veſſels full of red Juices, the lymphatic or watery Juices reddiſh, and the Fat gelatinous. By the ſame Organs, in an adult Perſon, the Bile ſeparated is ſharp or acrid, the Semen thick, the Milk ſweet or oily, the Urine yellow, thin, and alkaleſcent, the Womb diſcharges a menſtrual Blood, and lymphatic aqueous Humors, are moſt clear. But even in the adult Perſon, how different is the Urine; at one Time watery, at another thick or concocted, in a Fever high coloured and heavier, full of Salts and Oils. The Paſſions of the Mind, which make no other Change in the Body than that of Strictures in the Nerves, yet wonderfully change the Face of the Secretions, and expel even the Blood and Bile thro' the Veſſels of the Skin. Add to this the frequent Diſturbance of the Secretions, and Changes to which they are liable from ſlight Cauſes; ſo that only an increaſed Celerity ſhall cauſe ſeveral different Liquors to be ſecreted by one and the ſame Organ; for Serum and Blood have been known to paſs into almoſt all the Paſſages of the ſecreted Juices, into thoſe of the Sweat, Tears, Mucus of the Noſtrils and of the Womb, and into the lactiferous, ſeminal, and urinary Ducts, as well as the Fat. A true Milk has been ſeen ſeparated by Glands in the Thigh. When the Urine has been excreted by its natural Courſe through ſome Defect of the Kidneys, Ureters, or Bladder, it has paſſed by the Skin exhaled into the Ventricles of the Brain, or even into the whole cellular Fabric. The perſpirable Matter of SANCTORIUS, however this is often by Cold drove through the Noſe

Noſe or Kidneys, or by the ſame Cauſe, by Fear, or by Medicines, is depoſited through the excretory Villi of the Inteſtines. That exhaling viſcid Juice, ſecreted by the ſame Organ with the Fat, from which it ſo much differs, into the cellular Subſtance, is diſpoſed, takes Place of the Fat, is abſorbed and alternates again with the ſame, &c. A Salivation ſupplies the Place of the Sanctorian or cutaneous Exhalation externally, and of the cuticular Exhalation internally. The Bile reabſorbed appears evidently flowing in the Veſſels of the Eyes, nor does there appear any Thing in the Fabric of any of the Viſcera or Glandules that can fix or maintain the Nature of the ſecerned Fluid, but that a greater or leſs Velocity, or a Stricture of the Nerves, ſhall produce differently charged Juices in the intire Organs.

It now remains for us to diſcover, how the Secretions, in a healthy Perſon, become pure or uniform. For all the Juices, that have been lately ſecreted, (without excepting any, even the Oil or Fat itſelf,) have a great many watery Particles intermixed; ſo that none of the thicker watery ones, how then do the Semen, Bile, Fat, Mucus, and other thick Juices depoſite their firſt watery State, and acquire their proper viſcid and other Qualities?

For this End, therefore, Nature has framed Glands, with large and ſmall Follicles or Reſervoirs, for retaining the ſecerned Juices, from which the watery Parts are required to be ſeparated, to render the remaining Part more oblong and viſcid. The Mucus, at its firſt Depoſition, is thin, and watery as yet, but little differing from the perſpirable Vapours or Tears, in which State it diſtils into the Cavities of the Noſtrils, Trachea Arteria, and Inteſtines. This is not continually diſcharging, becauſe the excretory Duct, being ſometimes long

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and ſlender, ſo retards the Juice that it cannot paſs out by the Aſſiſtance of a Preſſure, or often, perhaps, not without a Sort of nervous Sphincter at its Orifice, be from the irritating Quantity or Acrimony of the Juice relaxed. This appears from the Morning Diſcharges of Mucus by blowing the Noſe, coughing up from the Lungs, and by ſneezing after the nocturnal Stagnation. In the mean Time the patulent Veins, extended into the Cavity of the Follicle, abſorb the more aqueous Parts from the thin Mucus, that it may become thicker, as it is retained longer, but if by the Force of ſome Stimulus, it be directly diſcharged after it is ſecreted, it comes out thin and watery. Examples of this we have in the Urethra, in the Noſtrils, and in the Ear-wax; as alſo the Bile, which, at its firſt Separation in the Liver, is watery, and has but little Yellowneſs or Bitterneſs. It is therefore, retained by a large Follicle or Gall-Bladder, and there digeſted or exalted by the vital Heat, and its more thin or watery Portion exhaled or abſorbed by the Veins; whence the Remainder becomes more thick, bitter, and oily, or ſaponaceous. The ſame Mechaniſm takes Place in the Semen, which, being reſerved in the ſeminal Veſicles, is there thickened, as to be very viſcid after long Chaſtity; but in repeated Venery 'tis expelled very fluid. In ſome Places Nature has made this Receptacle two or three times folded together in one and the ſame Organ, when her Deſign was to form a very thick Juice. Thus the ſeminal Paſſage is in the Cell reticular, in the End of the Epididymus one large Canal, ending in a large Veſicle; whence the Veſſels at the Teſticle are narrow and ſo again are the Vas Deferens with the proſtatic Duct.

Hence therefore, are never any Glandules placed in a Part, but for the Separation of a viſcid Juice;

Juice; or if a viſcid Liquor is any where ſeparated from the Arteries, without a glandular or follicular Fabric intervening, it then always ſtagnates in ſome larger Veſicle or Cavity, of which we have Examples in the Seed, Bile, Synovia of the Joints, and in the Fat.

A ſecerned Juice may be likewiſe changed in its Receptacle by Irritation or the Affuſion of ſome new Liquor. Thus the Semen thickens by an Affuſion of the proſtatic Liquor, the Chyle is thinned by Mixture of the ſalival and pancreatic Juice, and that which diſtils from the Villi of the Stomach and Inteſtines, and by an Affuſion of the Bile it becomes alcaleſcent: And again the Synovia or Albumen of the Joints tempered by Fat and medullary Oil.

But the great Uſe of Follicles and Receptacles of Glands is to preſerve the Juice, of whatever Kind it be, for thoſe Tunics in which it is moſt neceſſary to be employed in the Actions of Life. Thus the Bile is reſerved for the Time of Digeſtion, the Semen for due and lawful Venery, and the Mucus of the Noſe is accumulated in the Night to temperate the Force of refluent Air in the Day.

Therefore as Nature has in this Way framed Machines, by which the Juices are retarded in the large and ſmall Follicles, ſo ſhe has made others to expel them at ſuch convenient Times, to ſome Glands. She has given particular Muſcles for this Uſe, as in the Teſticles of Brutes, the urinary Bladder and the Gall-Bladder, or elſe ſhe has placed other muſcular Machines round them, which, by acting at convenient Times, expel the contained Fluids, as for Example, in the muſcular Tunic of the Stomach and Inteſtines. In other Parts ſhe has added contiguous and incumbent Muſcles

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to promote the Diſcharge, as in the Biventers and Muſcles of the lower Maxilla, or elſe ſhe has again joined to them a Kind of nervous Irritability, which, being excited to Action by an unavoidable Stimulus, opens the ſhut Paſſages to the Milk, Seed, Tears, &c.

The ſeveral particular Juices, which are derived from the Blood we ſhall deſcribe more accurately, under their reſpective Organs, but before we deſcend to the particular Secretions, it was neceſſary for us to ſpeak of Secretion in general, and eſpecially of that univerſal one, which is made of nutritious Serum or Lymph thro' all Parts of the Body; thus we may next proceed to the Appoſition or Accretion of it to ſupply the Deficiency of ſuch Parts as are daily waſting in the human Body.

Observations.

The Formation of the Fœtus in Utero. The different Fluids being formed as the Animal increaſes, each different Fluid as it is generated, finds its Way thro' the Pores which are already formed, as in the Arteries through thoſe which are on the Sides, and through the Glands, as they ſucceed each other in Generation; and this will be the ſame, whether the Gland of one protracted Tube or of Folliculi or Cryptæ.

Thus then theſe Glands, and theſe Pores, having once admitted ſuch particular Fluids will no more ſuffer others of a different Nature to paſs through, than the Paper dipt into Oil permits Water, or that in Water permits Oil to paſs through its Pores

In like Manner, in the Circulation of the Blood. As all theſe Particles are formed by the Action of 98 Degrees of Fire operating on that Fluid, whenever they paſs by and come within the Sphere of Attraction

Attraction of these Fluids already secerned, and continually secerning, they unite with them in the Pores like two or more Drops of Water into one; and thus the Glands continue to secern the same Fluid as long as the Animal continues healthy, and to admit no other; and by this Method it seems to be that all the Secretions of the animal Body are performed and continued.

However, if, through Want of animal Heat, proper Diet, or Infection, the Nature of those Fluids is changed, then another, the next in Similitude, takes Place, as in Leuco-Phlegmatics, pethechial and miliary Fevers.

From this Account, some Reason may be assigned why some Men can never be made fat, that Fluid having never been secerned in the infant State to any great Degree, there have been no Pores in this Body accustomed to let it pass through them sufficient to make any Degree of Fatness; for this Reason in emaciated States, where the Fat is exhausted, and a limpid Humour of another Nature has passed through the Pores, where the Fat went before, it is extremely difficult to restore the Person to his former Plumpness; the greater Dissimularity of the Fluids, the more difficult they take Place of each other.

Again, in Cases where the Bile is returned into the Blood, we see that it forces itself into all the lymphatic Arteries, as into those of the White of the Eye, and Urine not secerned, passes off thro' the Pores of the Skin, because those Fluids though sufficiently dissimilar to the native and natural ones, originally secreted in the Glands so as not readily to unite with them in the Circulation; yet, upon being forced back into the Blood in an over Proportion, they unite and go off along with others, as the Urine in Perspiration, and the Bile in the Urine.

A

COURSE

OF

Anatomical Lectures.

SPLANCHNOGRAPHY.

LECTURE I.

Of the PERITONÆUM and EPIPLOON.

AFTER the Abdominal Muſcles are removed, we immediately meet with a Membrane named Peritonæum, adhering cloſely to the interior Surface of the Muſcles of this Cavity, and inveſting all the Parts contained therein. The general Texture of this Membrane is pretty compact, and yet capable of conſiderable Expanſion and Contraction, as we obſerve in Pregnancy, Dropſies, &c. and afterwards returning to its primitive State.

It ſeems to be compoſed, at leaſt, of two Portions, one internal, the other external; which have

been looked upon, by many Anatomiſts, as a Duplicature of two diſtinct membranous Laminæ: But, properly ſpeaking, the internal Portion alone deſerves the Name of a membranous Lamina, as being the main Subſtance of the Peritonæum. The external Portion is no more than a kind of fibrous or follicular Apophyſis of the internal; and may properly be termed the cellular Subſtance of the Peritonæum.

The internal Lamina is moiſtened by a ſerous Fluid continually diſcharged through the imperceptible Pores * of the exhaling Veſſels.

The external Portion of the Peritonæum adheres very cloſely to the internal. It is not everywhere of an equal Thickneſs: In ſome Places there is a very ſmall Quantity; and ſcarcely any appears at the tendinous or aponeurotic Portions of the tranſverſe Muſcles, and on the inferior Surface of the Diaphragm.

Elſewhere it is thicker, and forms Cells expanded into very fine Laminæ; which, in diſeaſed Subjects, become ſometimes ſo broad, and thick, as to reſemble ſo many diſtinct Membranes.

In ſome Places this Subſtance is like a Membrana Adipoſa, filled with Fat; as round the Kidneys, and along the internal Surface of the tranſverſe Muſcles, to which it adheres. It intirely ſurrounds ſome Parts; as the Bladder, Ureters, Kidneys, ſpermatic Veſſels, &c. and it is, in theſe

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* Theſe Pores may be ſeen, by ſpreading a Portion of the Peritonæum on the End of the Finger, and then pulling it very tight on all Sides: For then the Pores are dilated, and ſmall Drops may be obſerved to run from them, even without the Help of a Microſcope.

The whitiſh Corpuſcles, found in diſeaſed Subjects, are no Proof of Glands, which ſome Anatomiſts place there in the natural State, as Dr. JAMES DOUGLAS imagined, in his Deſcription of the Peritonæum.

Places,

Places, improperly termed the Duplicature of the Peritonæum.

Beſides theſe Differences in Thickneſs, the cellular Subſtance has ſeveral Elongations, which have been called Productions of the Peritonæum. Two of theſe Productions accompany and inveſt the ſpermatic Veſſels, in Males; and the vaſcular Veſſels, commonly called the round Ligaments, in Females. There are two others, which paſs under the Ligamentum * Fallopii with the crural Veſſels, which they involve; and they are gradually loſt in their Courſe downward.

To theſe four Productions of the cellular Subſtance of the Peritonæum, we may add a fifth, which is ſpread on the Neck of the Bladder; and, perhaps, a ſixth, which accompanies the Inteſtinum Rectum. All theſe Elongations emerge out of the Cavity of the Abdomen, and may be termed external, to diſtinguiſh them from others that remain in the Abdomen, and are called internal.

The Aorta and Vena Cava are likewiſe involved in this cellular Subſtance of the Peritonæum: In a Word, it involves, immediately and ſeparately, all the Parts and Organs which are commonly ſaid to lie in the Duplicature of the Peritonæum.

The true Lamina, or membranous Portion of the Peritonæum, is connected, by the Intervention of the cellular Subſtance, to the inner Surface of the Cavity of the Abdomen; but it does not naturally accompany the external Elongations of that Subſtance. It only covers the Origin or Baſis of theſe Productions, without any Alteration in its own Surface in theſe Places.

* There is no ſuch Ligament, except you take the tendinous Extenſion of the Muſcles of the Abdomen.

It has, nevertheleſs, Productions of its own; but they are very different from thoſe of the cellulous; for they run, from without, inward; that is, they advance from the convex Side of the great Bag of the Peritonæum into the Cavity of it, ſome more, ſome leſs; and alſo different Ways; juſt as if the Sides of a large Bladder were thruſt inward into its Cavity.

Of theſe internal Elongations or Intropreſſions of the true Lamina of the Peritonæum, ſome are ſimply folded, like a Duplicature; ſome are expanded like inverted Bags, or Sacculi, to contain ſome Viſcus; ſome begin by a ſimple Duplicature, and are afterwards expanded into a Cavity which contains ſome Organ; ſome are alternately extended in the Form of ſimple Duplicatures, and of Cavities; and, laſtly, ſome form only a ſmall Eminence on the inner Surface of the great Cavity of the Peritonæum.

Under the firſt Species of theſe Productions, we may reckon the membranous Ligaments of the Abdomen; ſuch as thoſe of the Liver, Colon, *&c.* we ſee the ſecond Species in the external Membrane of the Liver; the third, in the Meſentery; the fourth, in the Meſocolon; and the fifth, at the Kidneys and Ureters.

Beſides the external Productions of the cellular Subſtance of the Peritonæum, it has the ſame Number of internal Elongations with the true Lamina; which lie between all the Duplicatures, and line the Inſides of all the Cavities, or that Side next the Viſcera contained in them.

The Uſes of the Peritonæum, in general, ſeem to be very evident, from the Deſcription which I have given of it: And the chief of theſe Uſes are, to line the Cavity of the Abdomen; to inveſt the Viſcera, contained in that Cavity, as in a common Bag;

Bag; to ſupply them with particular Tunics; to form Productions, Ligaments, Connections, Folds, Vaginæ, &c. as we ſhall deſcribe hereafter.

The fine Fluid, which tranſudes through the whole internal Surface of the Peritonæum, prevents the Inconveniencies which might ariſe from the continual Frictions, and Motions, to which the Viſcera of the Abdomen are expoſed, either naturally, or by external Impulſes.

It is to be obſerved, that the Peritonæum does not accompany the exterior Elongations of its cellular Portion: It covers the Baſe, or Beginning of theſe Elongations; and it is only in certain Hernias that it accompanies them, by ſlipping through the Aperture of the abdominal Muſcles; otherwiſe, theſe preternatural Elongations of the Peritonæum are called Herniary Sacks; becauſe they include, immediately, that Portion of the Inteſtine of the Epiploon which forms the Hernia. We ſay certain Hernias; for Experience evinces, that, in thoſe named Exomphalos, there is no herniary Sack; nor in the Hernias formed in conſequence of Wounds which penetrate into the Cavity of the Abdomen, &c. This ought to be carefully obſerved by Surgeons, in performing the Operation for theſe Hernias. VEDIER's Anatomy.

Of the EPIPLOON or OMENTUM, and APPENDICES EPIPLOÏCÆ.

The Omentum is a large, thin, and fine Membrane, contained, on all Sides, by numerous Portions of Fat, which accompany, and even inveſt, the ſame; with a great Number of Arteries and Veins adhering cloſely to each other.

Its greateſt Part reſembles a Kind of flat Purſe, or a Sportſman's empty Pouch; and is ſpread, more or leſs, on all the ſmall Inteſtines,

from the Stomach to the inferior Part of the Regio Umbilicalis. Sometimes it goes down to the inferior Part of the Hypogaſtrium, and ſometimes it does not reach beyond the Regio Epigaſtrica. It is commonly plaited, or folded, in ſeveral Places, eſpecially between the Bands of Fat.

It is divided into a ſuperior, and inferior; an anterior, and poſterior; and a right and left Portion. The ſuperior Portion is, in a Manner, divided into two Borders; one of which is fixed along the great Curvature, or convex Side of the Arch of the Colon; and the other along the great Curvature of the Stomach. The Commiſſure or Union of theſe two Borders, on the right Side, is fixed to the common Ligament, or Adheſion of the Duodenum and Colon, and to the contiguous Parts of theſe two Inteſtines. That on the left Side is fixed to the longitudinal Sciſſure of the Spleen, to the Extremity of the Pancreas, and to the convex Side of the great Extremity of the Stomach: It is likewiſe fixed to the membranous Ligament, which ſuſtains the Ductus Cholidochus, and connects it to the Vena Portæ Ventralis.

Below theſe Adheſions, the other Portions, that is, the anterior, poſterior, two lateral and inferior Portions, which laſt is the Bottom of the Sacculus Epiploïcus, have commonly no fixed Connections, but lie looſe between the Fore-ſide of the Cavity of the Abdomen and the Inteſtines.

The anterior and poſterior Portions are generally called the Laminæ of the Omentum; but as that Term is ordinarily employed to expreſs the Duplicature of ſome compound Membrane, it would be more convenient to call them Folia, Alæ, or ſome ſuch Name.

The Structure of the Omentum is, through its whole Extent, made up of two extremely thin Lamellæ, joined by a cellular Subſtance, the Quantity

tity of which is very considerable, along the Blood-Vessels, which it every-where accompanies, in broad Bands, proportioned to the Branches and Ramifications of these Vessels. These cellular Bands are more or less filled with Fat, according to the Corpulency of the Subject; and, for that Reason, I have called them Bands, or Portions, of Fat.

Omentum Minor.

Besides this large membranous Bag, which I name the Major Omentum, there is another much smaller, which differs from the large one, not only in Size, but also in Figure, Situation, and Connection; and this is named the Little Omentum. This small Bag is fixed, by its whole Circumference, partly to the small Curvature of the Stomach, and partly to the concave Side of the Liver, before the Sinus of the Vena Porta, so as to surround and contain the prominent Portion of the Lobulus.

This Omentum is thinner, and more transparent, than the other; and its Cavity diminishes gradually from the Circumference to the Bottom, which, in some Subjects, terminates in several small Cavities, or Fossulæ, more or less pointed. Its Structure is pretty much the same with that of the Great Omentum; it being composed of two Laminæ, with a Mixture of the same Portions of Fat, which are considerably finer than in the other.

We see, from this Situation of the two Omenta, that, in the Space left between the inferior Side of the Stomach and superior Side of the Mesocolon, they have a very broad Communication with each other; so that, if either of them contained in its Cavity any Fluid, that Fluid might readily get between the Stomach and Mesocolon, and so pass into the other Bag, especially when the Stomach

is empty; and, consequently, its Situation is easily changed.

Therefore, by means of this Interstice between the Stomach and Mesocolon, the two Omenta form one Cavity, which opens into the Cavity of the Abdomen by one common Orifice, situated near the Commissure on the right Side of the Great Omentum. This Orifice is semilunar, or semicircular, and formed by the Union of two membranous Ligaments; whereof one connects the Beginning of the Duodenum, and Neck of the Vesicula Fellis, to the Liver; the other connects the contiguous Portion of the Colon to the same Viscus, and extends to the Pancreas. From thence arises an incurvated Border, which surrounds the Root of the Lobulus, leaving an Opening wide enough to admit the End of the Finger.

To discover this Orifice of the Omentum, we need only raise, a little, the great Lobe of the Liver, and find out the Root of the Lobulus, and apply it to a large Pipe wrapped round with Cotton, Wool, or Tow, to hinder the Regress of the Air: Then, if we blow gradually, the Air will inflate the Sides of the Great Omentum, and give it the Appearance of a large Bladder, irregularly divided into several Lobes, or Tubercles, by the Bands of Fat, which appear, in this State, like so many Fræna between the Lobes.

This Experiment succeeds best, when the two Omenta are in their natural State, and handled very gently with the Fingers, first dipped in Oil. It succeeds better in young, lean Subjects, than in old or fat Subjects.

When we touch these Membranes with dry Fingers, they stick to them so closely, as hardly to be separated without being torn; as we see by the reticular Apertures which appear in those Portions of the Membranes that have been thus handled.

In

In that Caſe, it is to no Purpoſe to blow through the natural Orifice already mentioned; and it is owing to theſe ſmall Apertures, that the Membranes of the Omentum have been ſuppoſed to be naturally reticular.

The membranous Laminæ of the Little Omentum are continuous, partly with the external Membrane of the Liver, partly with that of the Stomach, and a little with the Membrane which lines the neighbouring Portion of the Diaphragm.

Thoſe of the Great Omentum are continued partly with the ſame Coat of the Stomach, and partly with the external Covering of the Colon, and, conſequently, with the Meſocolon; and they likewiſe communicate with the Covering of the Spleen.

We may ſatisfy ourſelves, concerning theſe Continuations, by making a ſmall Aperture in one of the Laminæ of the Omentum, near the Stomach, Colon, &c. and by blowing through a Pipe well fitted to it; for the Air will gradually inſinuate itſelf under the common Tunics of theſe Viſcera: But if the Parts be dry, they muſt be moiſtened a little before the Experiment is attempted.

Appendices Epiploïcæ.

The fat Appendices of the Colon and Rectum have always appeared, to me, to be a kind of ſmall Omenta, or Appendices Epiploïcæ. They are ſituated, at different Diſtances, along theſe Inteſtines, being particular Elongations of their common, or external Tunic. They are of the ſame Structure with the Great Omenta; and there is a cellular Subſtance, more or leſs filled with Fat, according to the Conſtitution of the Subject.

Next to the Inteſtine, each of them forms a broad thin Baſis; and they terminate by irregular Papillæ

pillæ, thicker than their Baſes. Theſe Baſes are, at firſt, diſpoſed longitudinally; then obliquely; and, laſtly, more or leſs tranſverſly, eſpecially near the Rectum, and upon that Inteſtine.

Theſe Appendices are, for the moſt part, ſeparated from each other; but ſome of theſe, which have longitudinal Baſes, communicate together; the Veſtiges of theſe Communications being very narrow, and not very prominent. By blowing through a ſmall Aperture, made in one of theſe Appendices, it is inflated like a ſmall irregular Bladder, and the Air paſſes under the external Coat of the Colon or Rectum.

Beſides theſe Appendices Epiploïcæ, we obſerve, at different Diſtances, along the Colon, between the ligamentary Band which lies hid, and one of the other two, that is, on both Sides of the Adheſion of the Meſocolon, ſeveral adipoſe Strata; which may likewiſe be looked upon as Appendices of the ſame Nature with the former; but theſe Strata are very ſeldom obſerved between the two apparent ligamentary Bands of the Colon.

As for the Uſes of the Epiploon, it is not to be doubted, but the Fat, with which it is loaded, has the ſame Uſes with that diffuſed through the whole Body; namely, to maintain the Flexibility of the fleſhy Fibres of the adjacent Muſcles: For Example, thoſe of the Stomach, Colon, and Duodenum, to which it adheres; and, by entering the Maſs of Blood, to aſſwage its Acrimony; and perhaps, according to the Opinion of ſome, to furniſh the different Parts of the Body with Nouriſhment when they cannot have it elſewhere.

The Epiploon aſſiſts, alſo, in the Preparation of the Bile, by ſupplying the Blood, which is diſtributed to the Liver through the Vena Porta, with a certain Quantity of ſulphureous Particles. And, laſtly, it is to be obſerved, that the Epiploon, by exactly

exactly filling the Vacuities left between the Stomach and Inteſtines, renders the Compreſſion, which theſe different Organs muſt receive from the Muſcles of the Abdomen, more gentle, and ſmooth; and, conſequently, more advantageous, both for the Digeſtion of the Aliment, and the Diſtribution of the Chyle.

Veſſels of the Omentum Major.

The Arteries and Veins of the Great Omentum are Branches of the Gaſtricæ, and, for that Reaſon, go by the Name of Gaſtro-Epiploïce, Dextræ and Siniſtræ.

The Arteries on the right Side anſwer to the Hepatic Artery; and thoſe on the left, to the Splenic; and both communicate with the Arteria Ventriculi Coronaria, and reſpectively with the Arteriæ Meſentericæ.

The Gaſtro-Epiploïc Veins anſwer, in the ſame Manner of Diſtribution, to the Vena Porta.

Thoſe of the Omentum Minor come chiefly from the Coronariæ Ventriculi; and thoſe of the Appendices and Strata are Ramifications from the reticular Texture of the Arteries and Veins of the Colon and Rectum.

Observations.

An uncommon Dropſy, from a ſteatomatous Omentum.

On opening the Body, it had the following Appearance; viz. the Belly hanging down over the Thighs, and monſtrouſly ſwelled every-where, but with a Depreſſion acroſs the Belly, about the Midway between the Navel and the Sternum, the lower Part of which was advanced, and the Point of the Xiphoïde Cartilage directed ſtrait forward. The Hypochondria were alſo conſiderably raiſed; the Thighs

Thighs and Legs were greatly ædematous, and the reſt of the Body was much emaciated.

The cellular Tunic of the Abdomen was very thin, without containing any Water in it. In cutting through the Muſcles and Peritonæum, on the left Side of the Navel, two Pounds of yellow Water ran out; and from the Cavity where this was lodged, ten Ounces of Pus were taken, with white tender Membranes ſwimming in it: Having cut the containing Part from the Navel to the left Loin, no more Water appeared; but eight Ounces of Pus were collected. All round the Cavity I obſerved a white hard Subſtance, compoſed of conjoined Veſicles, and adhering ſtrongly to the Peritonæum: This I cut through into the Cavity; and, raiſing the containing Parts ſtrongly, ſaw, behind them, a knotty Subſtance adhering to the Peritonæum, three Inches farther up, and then ſeparating from the Peritonæum, it was extended backwards, and ſupported a conſiderable Quantity of Water, lodged above it. I next cut off, from the Peritonæum, that Subſtance, which, being extended from one Side of the Abdomen to the other, divided the Cavity into two: After this, I divided the containing Parts, and turned up the two Quarters of the Teguments, now raiſed, on the Ribs, to have a better View of the veſicular Subſtance adhering to their internal Surface. It conſiſted of a fat Membrane, beſet with veſicular Bodies, either full of Mucus, or of a white, hard, ſteatomatous Subſtance. The epigaſtric Region was exceedingly inlarged; and out of the Cavity formed in it, I took thirty Pounds of Water, which had preſſed out the ſurrounding Bones, and thruſt the Diaphragm conſiderably upwards. I next diſſected the Teguments from the veſicular Body, as far as it reached, which was to the Oſſa Pubis, and there divided them.

All

All the Teguments being removed; below the Epigaſtrium appeared a large membranous Sac, of a browniſh black Colour, diſtended with Air, and reaching from the Extremity of the Cartilages of one Side, to thoſe of the other, when it ſunk down under both Hypochondria: The middle Part of it was much the largeſt; no Diviſion into Cells, or longitudinal Ligaments, were to be ſeen in it; though I found, afterwards, it was the great Arch of the Colon. The Part of the fat membranous Body left, when I cut this in raiſing the two ſuperior Quarters of the Teguments, mounted over this Sac, and then, ſinking backwards, adhered to another Viſcus; and from the lower Part of this ſame Sac, depended a white veſicular fat Subſtance, with large Blood-Veſſels ſpread on it. This, at firſt, was thin; but gradually, as it deſcended, became thicker, till it was hid by the anterior Lamella which had been diſſected off from the Peritonæum. When this laſt was raiſed, I ſoftly thruſt my Hand into a large Bag, formed between the two, as far down as the Oſſa Pubis, where they made one continued Subſtance. Beſides theſe, I could obſerve no other Viſcus except the Cæcum lodged in the Cavity of the right Ilia; wherefore I diſſected the veſicular Body away from all the Parts it adhered to: All the Cells, cut in this Diſſection, poured out Water. When this Body was wholly removed, I could not, at firſt, diſcover any Thing, in the Cavity below, except a flat circular Protuberance, lying on the Vertebra, covered with a dirty, black-coloured Membrane; and this, in a great many Places, had a white tender Membrane, reſembling the Skin formed on boiled Milk, when it cools, lying upon it.

The Cavities of the Loins were very large, and filled with Water, as well as the Pelvis; and, under the

the Water, Pus was every-where found: When these Liquors were taken out, the Surface of the Cavities had much the same Appearance with that of the larger middle Protuberance. The cellular Substance, surrounding the Pelvis, was two Inches thick, and distended with Water and Mucus.

I perceived a faint Resemblance of the small Intestines through the black Membrane, and discovered the Colon in the Loins. When the Membrane was taken off, all the Intestines came in View, of the Colour and Size usual in hydropic and emaciated Bodies; but the small Intestines, and Folds of the Mesentery, where they were contiguous, slightly adhered to each other by a weak sort of Membrane, which, when torn, yielded Water out of its Cells. The great Intestines were distended with Air, and in a natural Condition; the Mesentery was shorter than ordinary, but otherwise sound; the Stomach, hid in the great epigastric Cavity, was very little larger, in its transverse Diameter, than the small Intestines, but of a natural Colour: From its Fundus, the Remains of the cut Omentum depended, which was the vesicular Substance I at first divided in opening the Abdomen.

The Liver was hid under the false Ribs, and adhered so firmly to the livid Peritonæum, by its Membrane, which was about a Quarter of an Inch thick, that I could not observe its Colour, or Substance, till I had taken off the Membrane, when it looked pale, and had very little Blood in its Vessels. I found no Concretion in the Gall-Bladder; the Spleen was much in the same Condition with the Liver; the Pancreas was pale and hard; the Kidneys were in a natural Condition, but with little Blood in them; the Ureters were of the ordinary Size; the Bladder, Ovaria, Fallopian Tubes,

Tubes, and Uterus, were all ſound, only covered with a thick, livid Membrane: The Water and Pus weighed, in the Whole, forty Pounds.

The large veſicular Body conſiſted of two Lamellæ, which were thin above, but gradually turned thicker as they deſcended, till, at the loweſt Part, where they united, they were ſix Inches thick: Each was covered, all over, with a ſmooth Membrane, only the anterior was ulcerated at its ſuperior external Part. Several Ounces of purulent Matter, with Pellicles ſwimming in it, were taken out of the Cavity formed between the Laminæ. When the external Membrane was ſeparated, each ſeemed to conſiſt of Veſicles of different Sizes, ſome of which were diſtended with Water, others with Mucus, and a third Sort with a ſteatomatous Matter.

From the Whole, this Body appears to be the Omentum diſeaſed, which, probably, might be the Cauſe of the Dropſy, as well as Tumors of other Parts frequently are, of which I have ſeen ſeveral Examples. Is it peculiar to the membranous Parts, when ſuppurated, to have Pellicles mixed with the Pus? I have ſeen them in Inflammations of the Inteſtines and Pleura, as well as in the Omentum abovementioned.

Are theſe Pellicles, the Membranes, ſeparated, and turned tender, by ſoaking; or the Particles of the Pus adhering and preſſed firm? MONRO's Medical Eſſays, Vol. IV. Art. 30.

In Dropſies of the Abdomen, and in Perſons who, from any other Cauſe, have died tabid, it is generally rotten, and decayed; and ſometimes the Guts, in theſe Caſes, adhere to one another: But whether theſe Adheſions proceed from the Omentum's ceaſing to perform its Office, or from the periſtaltic Motion of the Inteſtines being long diſcon-

continued, through Abſtinence, or both, I cannot determine. CHESELDEN's Anatomy.

On opening the Body of a Woman, who had been, for the Space of fifteen Years, troubled with a Dropſy, by which her Abdomen was diſtended to the Circumference of three Ells, and the abdominal Blood-Veſſels were increaſed, in their Capacity and Thickneſs, beyond the Magnitude of the largeſt writing Quill. After a Number of Years, a Gangrene appeared above the Navel; by ſuppurating which, the Waters, contained in the Abdomen, burſt forth with great Impetuoſity; but we found the Omentum fleſhy, and of the Thickneſs of a Finger, faſtened to the Peritonæum, and including a Tumour as large as one's Fiſt; which being laid open, in Length, there firſt appeared a ſmall Quantity of a white thick Matter, without any ill Smell; which being diſcharged, we found the reſt of the Tumors to be nothing elſe but a Heap of Hairs, curled and twiſted together in an intricate Manner. Theſe Hairs were of different Lengths; ſome of them not being longer than one's Finger, and others were more than equal to a Span, in Length. Theſe Hairs, being viewed through a Microſcope, appeared, in every Reſpect, like thoſe of the Head, excepting that they had no Roots. The Viſcera had nothing uncommon. See RUYSCH's Obſerv.

A pregnant Woman, had, at the ſame Time, a Dropſy. She died ſome Time after ſhe was delivered. Upon opening her Body, and diſcharging the aqueous Matter, I found the Peritonæum, in ſeveral Places, indurated with Particles which reſembled Grains of Sand; and the Vena Porta was partly oſſified: The other Viſcera were pretty well, except the Omentum, which was intirely conſumed. Ibid.

Two

Other OBSERVATIONS on the Epiploon, &c. from STEPH. BLANCHARD, Cent. 2. Obſ. xlii. in his own Words.

Quidam de doloribus in Abdomine ad Jugulum deſcendentibus à longo tempore quæſtus; præſertim cum cibum ſumeret. Is ſubito expiravit.

Omentum habebat putridum cui fœtor aderat. Ingens erat Hepar, totumque fere Abdominis capacitatem implens. Lien exiguus. Hinc inde in Abdomine Veſiculæ flatibus diſtentæ. Exucci Pulmones lividi, & verſus gulæ regionem inflammati. Cor ſolito majus.

Steatoma Omenti monſtrorſum. Inteſtina juxta dextrum latus aſcendebant, quibus remotis Tumor ingens propria Tunica, ſatis craſſa, totam Abdominis capacitatem implebat, libras quinquaginta & ſex adæquans: Adhærebat Ventriculi fundo, partibuſque circumjacentibus. Continebat materiam adipi ſimilem, partim Glanduloſus fuit, partim quoque Scirrhoſus: Verum in medio cavitas fœtida, ſordidaque Sanie repleta fuit. Ibid. xxxvi Obſervatio.

LECTURE II.

Of the Oesophagus and Ventriculus.

THE Duct which, from the Bottom of the Mouth, extends to the Anus, may be distinguished into three Parts. The Oesophagus is the Portion between the Bottom of the Mouth and the Diaphragm: The second, which is a kind of Sack, is called the Stomach: And the third, which reaches from the Stomach to the Anus, comprehends all the Intestines, commonly called the Bowels.

The superior Part of the Oesophagus is dilated almost like the Mouth of a Funnel; and this dilated Portion is called the Pharynx.

The Oesophagus descends along the Neck; being placed behind the Trachea Arteria; running, however, a little to the left, in Proportion as it approaches the Breast, where it enters; and, continuing along the Vertebræ of the Back, it crosses the fleshy Portion of the Diaphragm, which corresponds to it, and at last terminates in the Stomach.

The Oesophagus is composed of several Tunics, or Membranes, and of Vessels, both sanguiniferous and lymphatic; with Nerves: We also find some small glandular Substances in it.

The first external Tunic is common to it with the adjacent Parts, and seems to be a Continuation

tion of the Membrane which lines the Cavity of the Thorax; and is called the Pleura: The second is fleshy, and composed of two Laminæ of Fibres, the exterior of which is longitudinal, and the interior circular.

This second is succeeded by a third, called the nervous Tunic, which appears to be formed of several tendinous Filaments, which cross each other in various Directions.

Lastly, The fourth, commonly called papillous, is very soft, porous, and always covered with a viscid Lymph, furnished by the glandular Granulations lodged behind it. In Conjunction with the nervous Tunic, it forms several Foldings, which run longitudinally along this Duct.

The Oesophagus is contracted and dilated by its Muscles.

There are great Numbers of Glands situated in the superior Part of the Pharynx; and excretory Osculæ, or Openings, are frequently discovered with them.

The Arteries of the Oesophagus are from the Carotids, the Aorta, the Intercostals, and the Cæliac.

The Veins run into the Jugulars, the Azygos, and the Coronary Vein of the Stomach.

The Nerves are from the Par Vagum. That there are also Lymphatics, is probable; but they are not easily discovered.

There are, also, certain excretory Ducts, called Ductus Excretorii Novæ Vercelloni*, which arise from the Glands, and convey a saltish Liquor into the Oesophagus and Stomach†.

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* Vid. Dissert. Anat. de Gland. Oesophag.

† Probably, when these Ducts are any ways obstructed, it may cause an Angina; as I have sometimes found the Glands quite ulcerated.

The Glands from which theſe have their Origin, are of three Kinds; viz.

1. The Gaſtric Glands, which are conglomerate, are ſituated near the left Orifice of the Stomach.

2. The Dorſal ones, which are ſituated near the fifth Vertebra of the Thorax.

3. The Bronchial, Tracheal, and Thyroïde, already deſcribed.

The Uſe of the Oeſophagus is for Deglutition, and a Commixtion of the Liquid ſerving for Digeſtion.

Of the VENTRICULUS, or STOMACH.

The Stomach is ſituated partly in the left Hypochondrium, and partly in the Epigaſtrium.

The Figure of the Stomach is like that of a Bagpipe; that is, it is oblong, incurvated, large and capacious at one End, and ſmall and contracted at the other. We ſee this Figure moſt evidently, when the Stomach is moderately filled with Air, or any other Fluid.

The Curvature of the Stomach gives us Occaſion to diſtinguiſh two Arches in it; one large, which runs along the greateſt Convexity; and one ſmall, directly oppoſite to the former. I call theſe Arches the great and ſmall Curvatures of the Stomach; and by the Sides of the Stomach, I mean the two lateral Portions which lie between the two Arches.

The Stomach has two Extremities, one large, and one ſmall, like a crooked Funnel. It has two Openings, called the Orifices of the Stomach; one between the great Extremity and the ſmall Curvature; the other at the End of the ſmall or contracted Extremity. The firſt Opening is a Continuation of the Oeſophagus; the other joins the

the inteſtinal Canal, and is called by the Name of Pylorus.

The Stomach is not ſituated in the left Hypochondrium and Epigaſtric Region, in the Manner repreſented in moſt of the Figures; it lies tranſverſly, obliquely, and almoſt laterally, in ſuch a Manner, as that the great Extremity, and the Orifice next it, are on the left Hand; and the ſmall Extremity, with its Orifice, or the Pylorus, on the right Hand; and lower, and more inclined, than the former: Therefore we ought, with the antient Anatomiſts, to call one of theſe Orifices ſuperior, the other inferior.

The great Extremity of the Stomach is in the left Hypochondrium, and, for the moſt part, immediately under the Diaphragm: Yet the ſuperior Orifice is not in the left Hypochondrium, but almoſt oppoſite to, and very near the Middle of the Bodies of the inferior dorſal Vertebra.

The ſmall Extremity of the Stomach does not reach to the right Hypochondrium; it bends obliquely backward towards the ſuperior Orifice, ſo that the Pylorus lies about two Fingers Breadth from the Body of the Vertebræ, immediately under the ſmall Portion of the Liver, and, conſequently, lower down, and more forward, than the other Orifice, by almoſt the ſame Diſtance. This Extremity of the Stomach has ſometimes a particular Dilatation on the Side next the great Curvature.

According to this natural Situation, the Stomach, eſpecially when full, lies ſo, as that the great Curvature is turned more forward than downward, and the ſmall Curvature more backward than upward.

One of the lateral convex Sides is turned upwards, the other downwards; and not forwards and backwards, as they appear in dead Bodies,

where the Intestines do not support them, in their natural Situation.

If we divide the Stomach, along the two Curvatures, into two equal Parts, we shall see, that the two Orifices do not both adhere to the same Half of this Division, as we should be apt to imagine, according to the common Notion; but that the diaphragmatic Orifice is intirely in the superior Half, and the intestinal Orifice in the inferior.

Therefore the Body of the Stomach is so far from lying in the same Plane with the Oesophagus, as it is commonly represented in Figures drawn from a Stomach taken out of the Body, and laid upon a Table; that it forms an Angle, or Fold, immediately at the Passage of the Oesophagus, through the small Muscle of the Diaphragm: And it is on Account of this Angle, that the superior Orifice is turned backwards.

As to the Structure of the Stomach, it is composed of several Parts; the chief of which are, the different Strata which form its Substance, to which Anatomists give the Name of Tunicæ, or Coats. These Tunics are commonly reckoned to be four in Number: The exterior, or common; the fleshy, or muscular; the nervous, or aponeurotic; and the villous, or interior Tunics. And they are afterwards subdivided several Ways.

The first, or exterior Tunic, is simply membranous; being one of the internal Productions of the Peritonæum. This appears evidently, at the Connection of the superior Orifice with the Diaphragm, where the external Membrane of the Stomach is really continuous with the Membrane which lines the inferior Surface of the Diaphragm; and it is from this that it has been named the common Tunic.

The

The ſecond, or muſcular Tunic, is made up of ſeveral Lamellæ of Fibres, which may all be reduced to two; one external, the other internal. The external Tunic is longitudinal, though in different Reſpects; following, nearly, the Direction of the Curvatures and Convexities of the Stomach; and the internal Lamina is tranſverſly circular.

The Fibres of the external Lamina run ſlanting in ſeveral Places, and are interſected by ſmall oblique whitiſh Lines, which ſeem to be, in ſome meaſure, tendinous. This Lamina is ſtrengthened by a particular Faſciculus, which runs along the ſmall Curvature; its Fibres appearing to be leſs oblique than thoſe of the great Lamina.

The Fibres of the interior or circular Lamina of this muſcular Tunic are ſtronger than thoſe of the external. They are rather Segments which unite at different Diſtances, than intire Circles; and they are, likewiſe, interſected by great Numbers of ſmall white Lines, in ſome meaſure tendinous, and very oblique; which all, together, repreſent a kind of Cancelli, the Areolæ or Meſhes of which are very narrow.

As theſe Circles, or Segments, advance on the great Extremity of the Stomach, they diminiſh gradually, and form a kind of muſcular Vortex, the Center of which is in the Middle of that Extremity.

Between the external and internal Laminæ, round the ſuperior Orifice, there are two diſtinct Laminæ, about the Breadth of a Finger, and very oblique, which ſurround this Orifice in oppoſite Directions, and interſect each other on the two Sides.

Along the Middle of each Side of the ſmall Extremity, there runs a tendinous or ligamentary flat Portion, above a Quarter of an Inch in Breadth, which terminates in the Pylorus. Theſe

two Portions lie between the common and muſcular Tunics, and adhere very ſtrongly to the firſt.

Between the ſame two Tunics there is a cellular Subſtance, which adheres very cloſely to the external Tunic, and inſinuates itſelf between the fleſhy Fibres of the ſecond, and all the Way to the third, as may be perceived by blowing it up. Some make it a diſtinct Tunic, and call it Tunica Celluloſa; but it is no more than the cellular Portion of the membranous Tunic, like the cellular Portion of the Peritonæum.

The third Tunic, commonly called Tunica Nervoſa, ſuſtains, on its convex Side, a very large reticular Diſtribution of capillary Veſſels, and Nerves: On the concave Side it ſeems to be of a very looſe Texture, and, as it were, ſpongy*, or filamentary; containing a great Number of ſmall glandular Bodies, eſpecially near the ſmall Curvature and ſmall Extremity of the Stomach.

The fourth Tunic of the Stomach is termed Villoſa; becauſe, when it ſwims in clear Water, ſome have imagined they ſaw ſomething in it like the Pile of Velvet. The Antients called it Tunica Fungoſa; and, perhaps, this Name agrees beſt with its true Structure. We obſerve in it a great Number of ſmall Apertures, anſwering to the ſmall Glands already mentioned.

Theſe two Tunics are of a larger Extent than the two former; and they contribute in forming large Rugæ on the concave Surface of the Sto-

* This ſpongy Texture reſembles fine Cotton; as may be ſeen, by macerating it a little in clear Water, which ſwells it conſiderably, in a very ſhort Time. It is ſupported by a kind of Ground-work of very fine ligamentary or aponeurotic Filaments, which interſect each other obliquely, much in the ſame Manner as the third Tunic of the Inteſtines, of which hereafter; and it adheres to the convex Side of the villous Tunic.

mach;

mach; the greateſt Part of which is tranſverſe, though irregular, and waving. There are, likewiſe, ſome longitudinal ones, which interſect the others; but at the Pylorus they all become longitudinal, and terminate there.

At the ſuperior Orifice of the Stomach theſe Rugæ are, in a Manner, radiated, and ſeem to be a Continuation of the Plicæ, or Folds, of the Oeſophagus; only they are thicker, and where theſe Rugæ, or Plicæ, meet, they form a ſort of Crown, which diſtinguiſhes the ſuperior Orifice of the Stomach from the inferior Extremity of the Oeſophagus.

In the Interſtices of theſe Rugæ, there is often found a ſort of ſlimy Mucus, which moiſtens the whole Cavity of the Stomach: This Mucus is much more fluid in living Bodies, and is ſupplied by the Glands of the Stomach. It may be termed Succus Gaſtricus, or Stomachicus.

On the interior Surface of the ſmall Extremity of the Stomach, at the Place where it ends in the inteſtinal Canal, we obſerve a broad, thin, circular Border, with a roundiſh Foramen in the Middle: This Aperture is the inferior Orifice of the Stomach, called, by the GREEKS, Pylorus, which ſignifies a Porter.

This Border is a Fold, or Duplicature, of the two interior Tunics of the Stomach, the Nervoſa and Villoſa; and it is formed, in part, by a Faſciculus of fleſhy Fibres, fixed in the Duplicature of the Tunica Nervoſa; and diſtinguiſhed not only from the other fleſhy Fibres of the Extremity of the Stomach, but alſo from thoſe of the Inteſtines, by a thin, whitiſh Circle; which appears even thro' the external or common Tunic, round the Union of the Stomach and Inteſtines.

The Figure of the Pylorus is that of a Ring tranſverſly flatted; the inner Edge of which, or that

that next the Center, is turned obliquely towards the Intestines, like a broad Portion of a Funnel. This inner Edge runs naturally, more or less, into little Plaits, or Gathers, like the Mouth of a Purse almost shut; very different from what Figures and dried Preparations would make us believe. It is therefore a kind of Sphincter, which can contract the inferior Orifice of the Stomach, but seems not capable of shutting it quite close.

The principal Arteries of the Stomach are, the Coronaria Ventriculi, which run along the small Curvature; and the two Gastricæ, that is, the Sinistra or Major, and Dextra or Minor; both which form one common Artery, which runs along the great Curvature.

The Coronaria Ventriculi becomes united in the same Manner with the Pyloricæ, and both make one common Vessel.

These two arterial Arches send a great Number of Branches towards each other on both Sides of the Stomach; and these Branches are gradually ramified, in different Directions, by very frequent Divisions and Subdivisions, the greatest Part of which communicate with those from the other Artery.

From these frequent Ramifications and Communications of the arterial Arches of the Stomach, two different reticular Textures arise; whereof one, which is the largest, lies between the common and muscular Tunics in the cellular Substance found there; the other, which is very fine, lies on the Surface of the Tunica Nervosa.

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* By Injections we can shew a third extremely fine reticular Texture of capillary Vessels, which run between the glandular Bodies and Papillæ of the Tunica Villosa. These do not seem, in the natural State, to be pure Blood-Vessels, as Inflammations and Injections may incline us to think.

This

This latter is a Production of the firſt, being formed by means of a great Number of very ſhort Rami, which go out from the other, and paſs thro' the ſmall Interſtices between the Fibres of the muſcular Tunic.

The Arteries of the Stomach come originally from the Cæliaca, by means of the Hepatica, Splenica, and Coronaria. The Pylorica and Meſenterica Superiora likewiſe contribute to them by Communications, more or leſs immediate. They communicate, alſo, with the internal Mammaric and Diaphragmatic, by means of the left Epigaſtric, with the inferior Meſenteric.

The Veins of the Stomach are Ramifications of the Vena Porta, in general; and, in particular, of the Meſaraica Major, Splenica, and Hæmorrhoïdalis Interna; the Diſtribution of which may be ſeen in the Deſcription of the Veins. They accompany the Arteries more or leſs, and form nearly the ſame kind of Arches, and reticular Textures; with this Difference, that they are proportionably greater, their reticular Areolæ larger, and their external Communications more frequent.

Between the common and muſcular Tunics of the Stomach, we find a great Number of Nerves, of different Sizes: Many of them accompany each other, in Form of a flat broad Faſciculus, along the ſmall Curvature of the Stomach, from the ſuperior to the inferior Orifice: The reſt are ſpread, in different Directions, on the Sides, Extremities, and great Curvature; forming, at different Diſtances, a kind of reticular Plexus, from which a great Number of Filaments are detached to the interior Tunics.

They ariſe, chiefly, from the Nervi Sympathetici Medii, or eighth Pair, by means of the Plexus Coronarius Stomachicus formed round the ſuperior Orifice of the Stomach, by the Expanſion of the Extre-

Extremities of two large Ropes, which run down upon the Oesophagus, by the Name of Nervi Stomachici. The great Sympathetic Nerve, commonly called Intercostalis, contributes likewise to them, by communicating Filaments, which the Plexus Stomachicus receives from the Semilunar Ganglion of the Plexus Hepaticus; and, particularly, from the Plexus Splenicus.

Office of the Stomach.

In the Capacity of the Stomach are conveyed Foods, sometimes crude, or in a tough State, and but little altered by Mastication; and those often of various Kinds, and Mixtures: Some of them being alcalescent, as Flesh Meats; rancescent, as oily or fat Substances; or acescent, as Bread, Milk, and most of the Vegetable Kind. These, we observe, are digested in a Heat equal to that of a hatching Egg; administered to the Stomach by the contiguous Spleen, Liver, and superincumbent Heart; and this in a Cavity altogether close or confined above; as it is also below, by the Ascent of the incurvated Pylorus, and its contractive muscular Valve. From whence we observe, that even Milk itself is often retained, in the Stomach of strong Animals, for several Hours after a Meal. Aliments are continually cohobated, or moistened, with watery Juices; and at the same Time repleniſhed with a good deal of Air, incorporated with them, either naturally, or in the Mastication. This Air, therefore, expanding, by the Force of Heat, Putrefaction, or Fermentation, breaks open the Cells by which it was included, divides the viscid Liquors, and softens or opens the solid Fibres, so as to make a Way for discharging their Juices. But the same Substance of the Air, turning to a Solid, makes the principal Glue, or Cement, by which the animal Solids, and

other

other Bodies, receive their Firmneſs: And this, being extricated by Heat, leaves the other elementary friable Particles without a Vinculum; as we ſee, from the Change of bony Subſtances in PAPIN's Digeſter, in the Stomachs of many Animals, and even in thoſe of ourſelves. This Air, ſet at Liberty, by Digeſtion, often diſtends the Stomach, more than the Food itſelf, under the Denomination of Wind, or Flatus. Whilſt this Air is extricated, the Aliments, by long Stay, begin to corrupt, or change into a nauſeous Liquid, either acid, mucous, putrid, or rancid; which two laſt happen leſs in human Bodies, from our Uſe of Bread, Salt, Wine, &c. For the Truth of which, we may appeal to the Flatus, and Matters eructated, often of a moſt fœtid, cauſtic, and inflammable Nature, from Subſtances of the like Diſpoſition. This Putreſcency, or imperfect Putrefaction, is almoſt the only Cauſe of Digeſtion, in Fiſhes, Serpents, and Carniverous Birds: Even in human Bodies we ſee, that Metals themſelves are, from theſe Cauſes, corroded, and diſſolved.

At this Time Hunger is abſent, the nervous Plaits of the Stomach being removed, and defended from their Contacts with each other, by the interpoſed Aliment, at the ſame Time that the Juice of the Stomach itſelf is leſs ſharp, and freer from a Mixture with the old Remains of the laſt Food; which often excite a nauſeating Uneaſineſs in the Nerves of the Stomach.

But that the Aliment might not degenerate into a complete Corruption, or Acrimony, for the moſt Part of the acid Kind; there is a Check from the putreſcent Degree of the Heat, the Quantity of Juices, diſtilling from the Stomach, and that of the Saliva itſelf ſwallowed to the amount of Half an Ounce in an Hour, and rather inclined to an Alca-

Alcaleſcency: Alſo, theſe Juices, being ground together with the Aliment; macerate, ſoften, and diſſolve, the Fibres themſelves, and their cellular Laminæ; leaving them a ſoft Pulp, like what we ſee, by letting them remain, for ſome Time, in warm Water.

There is, therefore, no particular Kind of Ferment, in the Stomach, from which the Deſign of Nature, the Diſpoſition of the Stomach, and its Uſe, are all very remote.

The nervous Fibres in the Stomach, being now irritated by the Flatus, Weight and Acrimony of the Food; begin to contract themſelves more powerfully than when the Stomach is empty, and with a greater Force, in Proportion as it is fuller: Becauſe the Expanſion, every Way, ſerves the Fibres as an Hypomoclion, or Point for Motion. And, firſt, the muſcular Stratum, which paſſes along the leſſer Curvature, connects the Pylorus with the Oeſophagus; and, being inſerted only into the left Face of the former, draws it to the right. The principal Stratum of the muſcular Fibres contracts the Capacity of the Stomach, according to its Length, grinds or intermixes its Contents, together with the Juices, and determines them both, like the Preſſure of ſo many Fingers, to flow towards the Pylorus. But this Flux, through the Pylorus, is not perpetual; becauſe the Motion begins from ſome Part which is more irritated; and from thence the Aliment is driven here upwards, as in other Parts downwards. In this Action of the Stomach, there is nothing which reſembles the Triture made by the ſtrong Gizards of Graniverous Fowls, which ſome Anatomiſts have aſcribed to the human Stomach; which, yet, has a conſiderable Degree of Strength; ſince the Contraction of its Fibres is often more than a third Part of their Length: For we frequently

quently see the Stomach reduced to less than a third Part of its Diameter, even to the Quantity of a few Ounces, with a Collapsion of its Sides.

But the stronger peristaltic Motion of the Stomach is that which it receives from the Diaphragm and abdominal Muscles: For, by the Pressure of these, the Stomach is more perfectly emptied, by a close Approximation of its anterior and posterior Sides. As it is principally by this Force, that Drinks are urged on continually, but Foods only when they are dissolved; lest those Parts, which are too gross, should be expelled through the Pylorus into the Duodenum, when the Stomach is more that Way inclined by Repletion: For the solid Aliments do not seem to leave the Stomach, before they have changed their fibrous, or other Texture, for that of a grey Mucus; dissolving into a yellowish and somewhat fœtid Pulp, like a Liquid. That which is first prepared, and turned fluid, goes, before the rest, out of the Stomach: First, Water; then Milk, Pot-Herbs, Bread, and, last of all, Flesh Meats; the harder, tougher, and longer Skins or Fibres of which pass unchanged. But such Things, or Bodies, as are hard, or too large to pass the Pylorus, are retained in the Stomach for a long Time*.

But as a considerable Portion of the Drink is absorbed, by the inhaling Veins of the Stomach itself, which open in the pendulous Villi, and exert a Force like that of capillary Tubes or Siphons, and are corresponding to the exhaling Arteries of the same Part; so their Contents take a more immediate or short Way into the Blood; as plainly appears, from repeated Experiments of injecting the Veins. Whether any Part may pass into the lymphatic Vessels, is doubtful.

* See Dr. ARBUTHNOT's Essay concerning the Nature of Aliments, &c.

The

The Stomach being irritated by too great a Quantity or Acrimony of the Food, or elſe by Sickneſs, a Repulſion of the Bile, or other Cauſe, does, by an antiperiſtaltic or reverted Motion of its Fibres, drive its Contents upwards, through the open and relaxed Oeſophagus, in the Act of Vomiting.

But then this Effect is partly from the Preſſure of the abdominal Muſcles depreſſing the falſe Ribs, and urging the Contents of the Abdomen againſt the Diaphragm; which, at the ſame Time, contracting itſelf to a Plane downwards, forces the Stomach, in a Manner, as betwixt the Sides of a Preſs, to throw up its Contents.

But the Aliments driven, in their natural Courſe, through the Pylorus to the Duodenum, meet there with the influent Bile and pancreatic Juices, which often flow back into the Stomach. But the former of theſe, being the principal Baſis of Chylification, will require from us a previous Hiſtory of the Viſcera, which convey their Blood through the Vena Porta, for the Secretion or Formation of the Bile, before we can proceed to inquire into the Nature and Effects of that powerful Humour.

Lymphatic Veſſels, I have obſerved, are ſometimes very conſiderable, about the leſſer Curve of the Stomach, ariſing from the Glandula of that Part; and inſerted, by a very large Trunk, into the Thoracic Duct: Others, no doubt, ariſe from ſmall Glandules, of the ſame Kind, in the greater Curve. As to the other lacteal Veſſels, more than theſe in the Stomach, I have never been able to ſee them; nor do I think they exiſt: Particularly thoſe lately deſcribed, and ſaid to paſs from the Stomach, through the Omentum, to the Liver, filled with a true Chyle.

Within the human Stomach we firſt meet with a great Quantity of Mucus, ſpread upon its villous Lining, from the Pores; which Mucus is not unfrequently tinged, by ſome of the Bile returning into

into the Stomach. Beſides this, in an empty Stomach, after faſting, upon bending the Body, a great Quantity of limpid or watery Humour will riſe into the Mouth, exactly of the ſame Nature with the Saliva; which Liquor is very rarely to be found pure, or unmixed, in the Stomach: For if it can be ſo had, free from any Mixture of the Food, it is far from poſſeſſing any acid or alcaline Acrimony: But, on the contrary, if it be free from acid or aceſcent Relics of the Food, it ſpontaneouſly changes, both in Man and Brutes, rather to a lixivial or alcaline Nature. This Liquor diſtils from the Arteries of the Stomach, through its villous Tunic, after the Manner we ſee by anatomical Injections; which is eaſily urged into the Veſſels of the Stomach, ſo as to perſpire through its Infinity of Pores.

The Stomach, then, contained within the Abdomen, which is perfectly full, will, from thence, as in a Preſs, receive a Force, or Preſſure, upon its Sides, which lie betwixt the Diaphragm; the Concavity of whoſe right Wing is filled by the Liver; under which, and within the left Wing, lies the Stomach, extended almoſt tranſverſly behind the reſiſting abdominal Muſcles. The more the Stomach is filled, the more it is urged by this Preſſure of the Muſcles; becauſe, at the ſame Time, it riſes upwards, in a right Angle, to the Contact of the Peritonæum.

Poſſibly, alſo, the Stomach abſorbs and retains the more ſubtil Particles of what it has thus prepared for Nutrition, eſpecially in Women giving Suck; by conveying it into their Mamillæ by ſome minute Canals, which are imperceptible when empty, like ſome of the lymphatic Veſſels.

It is alſo the Organ in which the Senſation of Hunger reſides. HALLER's Phyſiol.

The Signs of an Inflammation of the Stomach. These generally are, a burning, fixed, and pungent Pain; an Excerbation of this Pain, every Time any Thing is taken into it; a painful Vomiting, immediately after eating and drinking, accompanied with a tormenting Hiccough; a violent and perpetual Uneasiness about the Præcordia, with an acute continual Fever. The Causes of this Disorder are, either general Inflammations; the Contiguity of the Stomach to other inflamed Parts; or by taking in some acrid Substances, &c. It very often soon proves mortal, unless expeditiously cured, like other Inflammations. It terminates either in Health, or in suppuratory, scirrhous, cancerous, gangrenous Disorders; or sudden Death, by violent Convulsions. Boerhaave's Aphorisms.

Observations.

The Stomach is, in general, larger in Men, than in Women; yet I found the Stomach of a young Woman of an enormous Capacity.

We ought not to be surprised, if the Stomach, when considerably augmented in Bulk, descends lower than the epigastric Region, and even reaches below the Navel; as I have before observed. But it appears surprising, that, even in small Wounds of the Diaphragm, the whole Stomach should slip into the Thorax: This, however, has sometimes happened. Ambrose Pare says*, that in the Breast he found the Stomach, which had passed through a Wound in the nervous Center of the Diaphragm, which was not much above an Inch long. Fabricius Hildanus † relates a similar

* On Wounds in particular, Lib. X.

† Obs. Centur. 4. Obs. 33.

Obser-

Obſervation: And what is ſtill more ſurpriſing is, to find the Stomach in the Thorax without any Mark of a Wound in the Diaphragm. RIVERIUS ſays*, that, in the right Part of the Breaſt, he found the Stomach poſſeſſing the Place of the Lobe of the Lungs, which was wanting on that Side, and the Perſon never felt the Effects of this preternatural Situation of theſe Organs; having, for a long Time, enjoyed a perfect State of Health.

THOMAS BARTHOLINE alſo ſays†, that in the Breaſt he found the Stomach covered with the Epiploon. There is great Reaſon to believe, that theſe two laſt extraordinary Caſes depended on a Fault of the firſt Conformation. I ſhall here add a third preternatural Caſe, which alſo appeared to depend on a Fault of the firſt Confirmation.

Mr. MOUTON junior‖, opening a Fœtus of nine Months, was ſurpriſed, on opening the Abdomen, not to find the Stomach, nor Spleen; but, on opening the Thorax, he found the Stomach and Spleen, of the left Side, poſſeſſing the Place of the Lobe of the Lungs, which was wanting on that Side, and of which there was no Mark. Having examined the Diaphragm, he found an extraordinary Aperture of about an Inch and an Half in Extent, and ſituated at the Side of that which affords a Paſſage to the Oeſophagus: He alſo found, that one Lobe of the Liver, which was almoſt ſeparated from the reſt, had paſſed through this Aperture.

Mr. COURTOIS‡, who was preſent at this Diſſection, ſays, that he ſaw this particular Phænomenon, with all its Circumſtances.

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* RIVERIUS Obſ. Centur. 4. Obſ. 67.
† Vide THO. BARTHOLINE Hiſt. Anat. Centur. 6. Hiſt. 55.
‖ Surgeon of the Chirurgical Academy of Paris.
‡ Ibid.

After long Abstinence, and severe Pains, the Body is not only much emaciated; but sometimes, also, the Stomach, with the Intestines, were so contracted, that they are no larger than the Intestines. Fred. Ruysch's Observ.

A middle-aged Man, in low Circumstances, tall, corpulent, and of a very good Habit of Body, who wilfully starved himself to Death in a Stable: In dissecting him, I found all the Parts perfectly sound; but the Stomach and Intestines were intirely empty, without the least Remains of Excrement: The Bile was in great Quantity, so as not only to tincture the adjacent Viscera, but to fill a considerable Part of the Intestines. The Size of the Omentum was larger than any I ever saw; being an Inch thick; and it retained the Impression of the Intestines: The Mesentery and Mesocolon were very fat. In the Stomach, which was likewise tinctured internally with the Bile, there was, near the Pylorus, a great many Orifices of the muciferous Glands, about the Bigness of Pins Heads, which, when squeezed, emitted the contained Mucus. From hence it appears, that the Fat of a healthy Person is not very soon consumed, even after extreme Inanition; and that the Bile may likewise be squeezed out of the Gall-Bladder without any swelling of the Stomach. Haller's Patholog. Obs. 24.

In the Body of a Woman, the Peritonæum, Stomach, Duodenum, Colon, Gall-Bladder, and Liver, were all grown together in one confused Mass; shooting out, on all Sides, small white Fibres, which degenerated into a thick and soft Body; by which the above Parts were, in a Manner, glued together. So strong was the Cohesion, that the Colon could not be separated from the Stomach; and there was an open Passage, from that Intestine to the Stomach, formed by an Ulcer. Hence the

Colon

Colon was empty, and the Stomach, in the Part contiguous to the Colon, was very much disfigured by ſcirrhous Tumors and Abſceſſes, but had a ſound coronary Orifice. Upon inquiring into the Diſeaſe, I was told, that, about eight Years before her Death, ſhe was ſeized with an Illneſs, during her Lying-in, of which ſhe never perfectly recovered; and could neither ſpeak plain, nor bear any ſolid Food ever after: But moſt of her Suſtenance had been ſmall Beer, which ſupplied her juſt with ſufficient Strength to beg about the Town. HALLER's Pathol. Obſ. 23.

A large Crypta of the Stomach, found in a Woman of about Sixty-four Years of Age. According to her Daughter's Account of her, ſhe had been ſubject to complain of Pain in her Breaſt, loſt her Senſes, was much troubled with Worms, and frequent Bleeding at the Noſe. It was evident, that the Cataſtrophe had been finiſhed by a Dropſy, whereby the ſubcutaneous cellular Membrane, which inveſts the Muſcles, and that lines the Thorax, Pericardium, and Abdomen, were rendered turgid with Water. The Ventricles of the Brain were leſs affected. The Lungs, which is often the Caſe, had large Adheſions with the Mediaſtinum, Pericardium, and Diaphragm; the Aorta was full of Calloſities, which are frequent enough in old Subjects; and the Inteſtines ſwarmed with Worms: In the inferior Orifice of the Stomach there were ten or twelve hemiſpherical Tubercles, reſembling Nipples, produced by the villous Tunics; the Points of theſe Tubercles were either black, or quite perforated; their Cavities full of Pus, and their Dimenſions very different; ſome of them being about three Lines in Diameter, and others an Inch. This was a very ſingular Caſe; and affords a Conjecture, whether the Diſeaſe was owing originally to the Worms corroding

roding the Stomach, or to an Obstruction of the Cryptæ of the Stomach, which these Tubercles resembled very much in their Figures, but they were greatly increased in Size. Her Appetite and Digestion continued pretty good. HALLER's Pathol. Obs. 22.

A young Man received a Kick in the Belly, which occasioned a continual Pain in the anterior Part of his Abdomen, with a great Weakness of Digestion; and these Symptoms were succeeded by a slow Fever, which at last proved mortal. Upon dissecting his Body, the Omentum was, as it were, folded up, and about an Inch and a Half thick. It adhered very firmly to the Liver and Stomach. Within it was a fœtid putrid Pus, and the very Substance of the Stomach was turned to a kind of grumous bloody Cancer. Ibid. Obs. 25.

LECTURE III.

Of the general Situation, Size, and Diviſion, of the INTESTINES.

FROM the Pylorus to the inferior Part of the Abdomen, lies a long Tube, bent into various Directions and Convolutions, called the Inteſtines.

This Tube, or Canal, thus folded, fills the greateſt Part of the abdominal Cavity; and it is connected, through its whole Extent, to membranous Productions or Continuations of the Peritonæum; but principally to thoſe called the Meſentery and Meſocolon.

This Incurvation of the inteſtinal Canal forms two Arches: A ſmall one, by which it is connected to the Meſentery and Meſocolon; and a large one, on the oppoſite Side, which lies looſe. The whole Canal is generally ſaid to be about ſix Times as long as the Subject duly proportioned.

This Canal is neither of an equal Size, nor Thickneſs, through its whole Length; whence Anatomiſts thought proper to divide them into Tenuia, or ſmall; and Craſſa, or great.

They likewiſe ſubdivided each Claſs into three Portions, which they diſtinguiſhed by particular Names. The ſmall ones are, Duodenum, Jejunum, and Ileum; the great ones, Cæcum, Colon, and Rectum.

Structure of the INTESTINES. In general they are compoſed of ſeveral Tunics, much in the ſame Manner with the Stomach. The firſt exterior is a Continuation of the Meſentery, or of ſome other Elongation or Duplicature of the Peritonæum.

This is generally termed the common Tunic; and it has a cellular Subſtance, on its interior Surface, like that of the Stomach; which RUYSCH thought fit to call a diſtinct Tunic, by the Name of Tunica Celluloſa.

The ſecond Tunic is muſcular, and forms two Laminæ; one external, the other internal.

The external is very thin, and its Fibres longitudinal; the internal is thicker, and its Fibres run tranſverſly round the Circumference of the inteſtinal Cylinder.

Theſe two Laminæ adhere cloſely together, and are not ſeparated without great Difficulty: They likewiſe adhere to the common Tunic, by the Intervention of the cellular Subſtance, which is in greater Quantity on the Side next the Meſentery, than on the other.

The third Tunic is called Nervoſa, and is ſomewhat like that of the Stomach. It has a particular Lamina, which ſerves as a Baſe to ſuſtain it, conſiſting of very fine, ſtrong, oblique Fibres, which ſeem to be of the ligamentary or tendinous Kind.

To inſpect this Lamina diſtinctly, a Portion of the Inteſtines muſt be inflated, and the common Tunic removed, with the muſcular Fibres ſcraped.

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* Dr. WINSLOW is not of Opinion, that theſe Fibres are ſpiral, nor that they are perfect Circles, or Rings: But they ſeem rather to be Segments of Circles, diſpoſed much in the ſame Manner as thoſe of the Stomach, and ſurrounding intirely the inteſtinal Canal.

This Tunic retains two reticular Subſtances, which are both vaſcular; one arterial, the other venal; accompanied by a great Number of nervous Filaments. Theſe Veſſels and Nerves are Productions of the meſenteric Veſſels and Nerves: And as they ſurround the whole inteſtinal Canal, ſome Anatomiſts have formed them into a diſtinct Tunic, by the Name of Tunica Vaſculoſa.

The nervous Tunic ſends off from its inner Surface a great Number of Portions of Septa, more or leſs circular, which contribute to the Formation of what are called Valvulæ Conniventes: It likewiſe ſeems to ſuſtain ſeveral different glandular Bodies which are diſcovered in the Cavity of the Inteſtines.

The fourth, or interior Tunic, is very ſoft, and named Tunica Villoſa. It has the ſame Extent with the third Tunic, which ſupports it; and it lines all the Septa of that third Tunic; but it is not uniform through the whole Canal, as we ſhall ſhew, in its particular Deſcription.

The Intestina Tenuia. The ſmall Inteſtines form one continued uniform Canal: And though three Portions of it have three different Names, yet we have no ſufficient Marks whereby to diſtinguiſh them, to fix the preciſe Extent or Length of each Portion, or to ſettle its juſt Limits.

The firſt and ſmalleſt, or, properly ſpeaking, the ſhorteſt Portion of the whole Canal, is called Duodenum; the ſecond, which is much longer, Jejunum; and the third, which is ſtill longer than the ſecond, Ileum.

Situation, Connection, and Structure, of the Duodenum. The firſt Portion of this Inteſtine was called Duodenum, from the Length aſcribed to it by the Antients; viz. the Breadth of twelve Fingers: And the Moderns need not cavil much about

about this Length, if it is meaſured with the Ends of the Fingers of the Subject.

This Inteſtine having ariſen from the Pylorus, is immediately bent a little backwards, and obliquely downwards; then it bends, a ſecond Time, towards the right Kidney, to which it is a little connected; and from thence paſſes before the renal Artery and Vein, aſcending, inſenſibly, from right to left, till it gets before the Aorta; and, laſtly, the dorſal Vertebra. It continues its Courſe obliquely forward, by a gentle Turn, which may be reckoned a third Incurvation, and alſo the Extremity of the Duodenum.

Through its whole Courſe it is firmly bound down by Folds of the Peritonæum, eſpecially by a tranſverſe Duplicature which gives Origin to the Meſocolon. The two Laminæ of this Duplicature, being at firſt ſeparate, and ſoon after uniting, muſt leave a triangular Space between them, which is lined with a cellular Subſtance.

It is in this Space that the Duodenum adheres, by means of the cellular Subſtance, to the Parts already named; and the Inteſtine is contained therein, as in a Caſe: So that, without Diſſection, we can ſee nothing but its two Extremities; and even theſe are hid by the Colon, and the firſt Convolutions of the Jejunum.

The firſt Tunic of the Duodenum is, conſequently, different from that of the other ſmall Inteſtines; having this peculiar to it, that it does not inveſt the whole Circumference of the Inteſtine; becauſe, through the greateſt Part of its Length, it lies in the triangular Space already mentioned: And, for the ſame Reaſon, there is a greater Quantity of cellular Subſtance belongs to the exterior Tunic of the Duodenum, than to that of the other Inteſtines.

The

The muſcular Tunic is thicker than that of the Jejunum, or Ileum.

The Tunica Nervoſa and Villoſa form conjointly, on the Inſides of this Inteſtine, a great Number of ſmall Duplicatures, which advance to the Cavity more or leſs directly, like Portions of circular Planes, with one Edge fixed to the Inteſtines, and the other looſe: Theſe are what Anatomiſts call Valvulæ Conniventes.

The looſe or floating Edge of theſe Valves is formed into ſmall Gathers, or Valves, in the natural State. I ſay deſignedly in the natural State, to rectify the falſe Ideas which dry Preparations of the Inteſtines are apt to beget. The whole Surface of theſe Duplicatures, or Valves, is villous, as well as that of the Interſtices between them.

The Villi of this Inteſtine are thicker than in the Stomach; but the Texture of them in Man, is not like Hairs, as they are commonly repreſented in Figures; but rather like that of a fungous, granulated Subſtance, compoſed of an infinite Number of very fine Papillæ, of different Figures, in which we ſee, through a Microſcope, a Multitude of depreſſed Points, or Pores, by which their whole Surface ſeems to be pierced.

By the ſame Help, we obſerve, on different Places of the inner Surface of this Inteſtine, ſeveral round villous Tubercles, riſing, like ſmall Verrucæ, at different Diſtances from each other.

This Subſtance ſuſtains an infinite Number of capillary Veſſels, of different Kinds: For, beſides the Blood-Veſſels, we ſometimes obſerve a great Number of white Filaments, which run through it, and end at its inner Surface, like ſo many capillary Roots of the Veſſels called Venæ Lacteæ.

The fungous Subſtance which binds theſe capillary Filaments together, and ſurrounds them, is very

very tender; and the capillary Extremities of the ſmall Blood-Veſſels, diſtributed through it, ſeem to be turned towards the Pores of the Papillæ. Through theſe Pores, a mucous Fluid, more or leſs tranſparent, is diſcharged, which continually moiſtens the Cavity of the Inteſtine.

Glands of the DUODENUM. The internal Surface of the Duodenum is furniſhed with a great Number of ſmall, flat, glandular Tubercles, raiſed on the Sides, and depreſſed in the Middle, by a kind of Foſſula; and they are more numerous near the Beginning of this Inteſtine, than anywhere elſe.

About the Pylorus, they lie, in a Manner, in Heaps, or Cluſters; and from thence the Diſtance between them increaſes gradually, all the Way, to the other Extremity, where they are ſingle.

Theſe Glands, when examined carefully, appear like little Bladders, with the Orifices turned towards the Cavity of the Inteſtine, and the Bodies fixed in the ſpongy Subſtance next the nervous Tunic. They furniſh a particular Fluid, which is often found to be viſcid.

On the internal Surface of the Duodenum, almoſt at the inferior Part of the firſt Incurvation, and on the ſhorteſt Side, there is a longitudinal Eminence; in the Point or Apex of which lies the Orifice of the Ductus Bilarius, within which the Ductus Pancreaticus likewiſe opens.

This Inteſtine is commonly the wideſt, though the ſhorteſt of the Inteſtina Tenuia, and is inveſted by more cellular Subſtances, eſpecially while within its triangular Caſes, where it wants the exterior Tunic, which the others have; and, conſequently, it is more eaſily dilatable, by the Subſtances which might otherwiſe ſtick within it.

Situ-

Situation, Size, and Structure of the JEJUNUM. This Inteſtine is ſo called, becauſe it is oftener found more empty than the Ileum, which begins at the laſt Incurvation of the Duodenum, where it is connected to the Beginning of the Meſocolon.

From thence it bends downwards from left to right, and obliquely forwards, or from the Vertebræ; and makes ſeveral Convolutions, which lie chiefly in the ſuperior Part of the umbilical Region. Through all this Courſe, it is connected to the Meſentery.

It is a pretty difficult Matter to fix the exact Bounds between this Inteſtine and the Ileum. The external Marks being of a redder Colour in one than in the other, though pretty common, are not conſtant; and the internal Marks, fixed from the Plurality of Valvulæ Conniventes, are indeterminate, and oftentimes appear only from Diſſection.

The Tunics of the Jejunum are nearly of the ſame Structure with thoſe of the Duodenum, but thinner. The common Tunic is a Continuation of the Meſentery; and the cellular Subſtance is in leſs Quantity than in the Duodenum; and indeed ſeems to be altogether wanting along the great Curvature of the Convolutions, where the longitudinal Fibres of the muſcular Tunic adhere very cloſely to the external Membrane.

This muſcular Tunic is not ſo ſtrong as that of the Duodenum. The longitudinal Lamina of Fibres is very thin, and almoſt imperceptible, except along the great Curvature oppoſite to the Con-

* Theſe two Inteſtines may be better diſtinguiſhed by their different Situations, which are pretty regular: But as even this Mark is not particular enough, the eaſieſt Way that I have been able to contrive, and which will, in moſt Caſes, be found ſufficiently exact, is, to divide both the Inteſtines into five Parts; and to allow nearly Two-fifths to the Jejunum, and a little more than Three-fifths to the Ileum.

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nection of the Meſentery, where we ſee through the membranous Tunic a kind of whitiſh ligamentary Band, about the third Part of an Inch in Breadth, which is continued along the great Curvature of all the Convolutions of this Inteſtine, and of the Ileum.

This ligamentary Membrane is like thoſe which we obſerve on the Sides of the ſmall Extremity of the Stomach. It adheres perfectly to the membranous Tunic, and to the longitudinal Fibres of the muſcular Tunic, which are here more viſible, and appear to be ſtronger than in any other Place.

The Tunica Nervoſa, which I chooſe rather to call Reticularis, and its proper cellular or lanuginous Subſtance, have nothing peculiar to them more than has been already ſaid about the Inteſtines in general. By blowing artfully into this Subſtance, it may be made to ſwell ſo much, round the whole Cavity of the Inteſtine, as to deſtroy all the Duplicatures, or Valvulæ Conniventes.

Theſe Valves, in this Inteſtine, are very broad, numerous, and very near each other. On the Side of the great Curvature their Circumference is continuous, and uniform; but next the ſmall Curvature there are ſeveral Breaks in them; the Extremities of ſome advancing beyond the reſt, and terminating in Pores. Some of theſe Valves go quite round, others only ſome Part of the Way, and ſome of them are very ſmall, which go obliquely between two large ones, forming a kind of Communication.

The Papillæ * of the Tunica Villoſa are here more raiſed, looſe, and floating, than in the Duodenum; and each of them ſeems to be divided

* The Obſervations and Figures, publiſhed by Dr. HELVETIUS, in the Memoirs of the Royal Academy of Sciences, expreſs theſe Papillæ, and the whole Tunica Reticularis, very juſtly. Dr. WINSLOW.

into

into ſeveral others, by Inciſures of a very ſingular Kind: In other Reſpects they agree pretty much with what was ſaid in the Deſcription of the Inteſtines in general.

The glandular Lacunæ of the Jejunum are of the ſame Structure with the Glandulæ Bruneri, or Duodenales; but they are diſpoſed in a different Manner. They are partly ſingle, at different Diſtances from each other; and partly in ſeveral Cluſters, like flat oblong Bunches of Grapes, called Plexus, Glanduloſi Peyeri.

Theſe are in the largeſt Quantity near the great Curvature, and they croſs through ſeveral Valvulæ Conniventes at once.

Situation and Structure of the Ileum. The Convolutions of this Inteſtine ſurround thoſe of the Jejunum on the two inferior Sides; and it paſſes, in a winding Courſe, from the left Side, by the Hypogaſtrium, to the right, where it terminates a little below the right Kidney; joining the Inteſtina Craſſa in the Manner which I ſhall relate hereafter. The lateral Convolutions are ſupported by the Oſſa Ilium; ſo called, not from this Inteſtine, but from the Region of the Abdomen termed Ilia.

The Structure of the Ileum is much the ſame with that of the Jejunum; only the internal Duplicatures, or Valvulæ Conniventes, decreaſe gradually, both in Number and Size. Near the Extremity of the Ileum their Direction is changed; and, inſtead of being tranſverſe or circular, they become longitudinal, and terminate in a kind of Pylorus, which advances into the Cavity of the great Inteſtines, as we ſhall ſee preſently.

We obſerve likewiſe, in this Inteſtine, as in the Jejunum, ſingle or ſolitary Glands, or Lacunæ; and alſo reticular Glands, or Glands in Cluſters; the laſt of which, at the Extremity of this Inteſtine,

tine, is oftentimes of great Extent; but the greateſt Part of theſe Glands appear to be flatter here than in the Jejunum. The cellular Subſtance of the external Tunic is in leſs Quantity than in the foregoing Inteſtines, and the Ileum commonly appears paler than the Jejunum.

The Veſſels, Nerves, Connections, &c. muſt be referred to the Hiſtory of the Meſentery.

Intestina Crassa in general. The great Inteſtines are one continued Canal, divided into three Portions, like the ſmall ones: This Canal begins by a kind of Sacculus, or Bag, which is reckoned the firſt of the three Portions, and called Cæcum.

The ſecond Portion, called Colon, is the longeſt of the three; and is diſtinguiſhed from them by a great Number of particular Eminences, or Convexities, which appear on its external Surface through its whole Length.

The laſt Portion is named Rectum; being more uniform, narrower, thicker, and much ſhorter, than the Colon.

The Structure of the great Inteſtines is nearly the ſame with that of the ſmall ones, in regard both to the Number and Diſpoſition of their Tunics. They are ſhorter, and have fewer Convolutions; but are much more capacious. The Tunics in general are ſtronger, eſpecially the muſcular ones; the Villi and mucilaginous Glands are different; and there are ſeveral other Things, relating to them, which will be deſcribed in their proper Places.

Situation and Structure of the Cæcum. The Inteſtinum Cæcum is only a round, ſhort, broad Bag, the Bottom of which is turned downwards, and the Mouth, or Opening, upwards: It lies under the right Kidney, and is hid by the laſt Convolution of the Ileum. It is about three Fingers Breadth

Breadth in Length, and its Diameter is more than double that of the ſmall Inteſtines.

Appendicula Vermiformis. On one Side of the Bottom of the Cæcum lies an Appendix reſembling a ſmall Inteſtine, nearly of the ſame Length with the Cæcum, but very ſlender. It is termed Appendicula Vermiformis, from its ſuppoſed Reſemblance to an Earth-Worm. Its common Diameter is not above a Quarter of an Inch. By one Extremity it opens laterally, and a little obliquely into the Bottom of the Cæcum; and the other Extremity is cloſed; being ſometimes greater, ſometimes ſmaller, than the reſt of the Appendix.

It has ſome Contortions, like thoſe of a Worm when it is touched; from whence comes the Epithet, Vermicularis, or Vermiformis: And it may likewiſe be compared to the Gills or Pendants of a Turkey Cock. Its Structure reſembles nearly that of the other Inteſtines.

The internal Tunic of this Appendix is folliculous, like that of the Duodenum; and it is likewiſe reticular, the Meſhes being the glandular Lacunæ, which continually diſcharge a Fluid into its Cavity.

It has been often diſputed, whether this Appendix, or the larger Portion, which is, as it were, the Head of the Colon, ought to be called the Cæcum: But the general Diviſion of the Inteſtines into great and ſmall, leaves no room to doubt of its being only an Appendix in Man; whatever Reaſon there may be for talking differently with reſpect to Brutes and Birds.

Through the membranous or common Tunic of the Cæcum, we find three ligamentary Membranes, which adhere very cloſely both to the external and muſcular Tunic. One of them is hid by the Adheſion of the Meſocolon; and all the

three divide the Cæcum longitudinally into three Parts more or leſs equal.

They all unite on the Appendicula Vermiformis, and cover its whole exterior Side immediately under the common Tunic. Though they appear exteriorly on the Cæcum to be ligamentary, they are made up interiorly of fleſhy Fibres, which accompany and ſtrengthen the longitudinal Fibres of the muſcular Tunic.

The villous Subſtance of the interior Tunic of the Cæcum is very ſhort, and furniſhed, in ſeveral Places, with glandular Lacunæ, or ſolitary Glands, broader than thoſe of the ſmall Inteſtines.

Theſe glandular Lacunæ, or Folliculi, are flattened and depreſſed in the Middle, like the Small Pox. When we blow through a Pipe into theſe Lacunæ, without touching them, the Folliculi are inflated, and repreſent little Caps, with an Aperture in the Middle of the convex Side.

Situation and Structure of the Colon *. The Colon is the moſt conſiderable of all the Inteſtines. From the Cæcum, of which it is a Continuation, it reaches, in Form of an Arch, above the umbilical Region, to the inferior Part of the left Hypochondrium. Its Continuity is, however, a little interrupted by the Ileum, which advances into the Cavity of the Colon, and, together a certain Fold of that Inteſtine, forms what is called Valvula Coli.

The whole convex Side of the Colon is divided longitudinally into three Parts, by three ligamentary Membranes, continued from thoſe of the Cæ-

* A monſtrous Dilatation of the Inteſtinum Colon, in a Girl of five Years old. On opening her Body, we could hardly perceive any of the abdominal Viſcera, except that Part of the Colon where it begins to aſſume the Name of Rectum; by reaſon of the enormous Extenſion of the Colon, under which all the Viſcera lay concealed. Ruysch, Obſerv. 92.

cum, and of the ſame Structure with them. Two of theſe membranous Ligaments run on each Side along the great Curvature of the Colon, and the third along the ſmall Curvature.

The ſuperior ligamentary Membrane, of the two which belong to the great Curvature, is the broadeſt of the three; that which belongs to the ſmall Curvature is the narroweſt, and lay hid, by the Connection of the Meſocolon, till it was brought to light by MORGAGNI.

Theſe three longitudinal membranous Ligaments do the Office of longitudinal Fræna, between which this Inteſtine is, through its whole Length, alternately depreſſed into tranſverſe Folds, and raiſed into conſiderable Eminences. All the Folds are Duplicatures, which form Portions of Valvulæ Conniventes in the Cavity of the Inteſtine; and the Eminences form Receptacles, called the Cells of the Colon.

All the Tunics of the Colon concur equally to the Formation of theſe Duplicatures and Cells, the Depth of which decreaſes gradually towards the Extremity of the Inteſtine; and neither of them go any farther than the ligamentary Membranes.

Theſe Portions of the Colon, which are immediately covered by the ligamentary Membranes, are ſmooth, and without Rugæ; and therefore if theſe Membranes, alone, are cut croſs-ways, the Inteſtine is not elongated ſufficiently to deſtroy all the Folds and Cells.

The common Tunic on one Side is a Continuation of the Meſocolon, and on the other Side it contributes, by the ſame Continuation, to form the Omentum.

The longitudinal Fibres of the muſcular Tunic are very ſlender; and thoſe which anſwer to the annular or circular Fibres of the ſmall Inteſtines,

are only Segments ſtretched over the Eminences and Folds: The other Tunics are nearly as in the Cæcum; only the glandular Lacunæ, or ſolitary Glands, are broader, and more numerous.

The Arch of the Colon begins under the right Kidney. It runs up on the anterior Side of that Kidney to which it is connected; paſſes under the Veſicula Fellis, which tinges it with a yellow Colour at that Place, and continues its Courſe before the firſt Incurvation of the Duodenum, to which it adheres, and partly hides it. In this Part of its Courſe, therefore, there is a remarkable Connection between the Colon, Duodenum, right Kidney, and Veſicula Fellis.

From thence the Arch of the Colon runs before the great Convexity of the Stomach, and ſometimes a little lower; then turns poſteriorly under the Spleen in the left Hypochondrium, and runs down on the anterior Side of the left Kidney, to which it is connected; below this Kidney turns towards the Vertebræ, and terminates there by a double Incurvation, or by two oppoſite Convolutions, which repreſent, in ſome meaſure, a Roman S.

Theſe laſt Convolutions of this Inteſtine are ſometimes multiplied, and even advance to the right Side of the Pelvis; and along the great Arch, and the two laſt Incurvations, there are a kind of Fringes, called Appendices Coli Adipoſæ, which I ſhall hereafter explain, as alſo the Connections of the Colon with the Meſocolon and Omentum.

Valvula Coli*. At the Place where the

* In the Medical Eſſays, Vol. IV. Art. 31. is given an Inſtance of the Paſſage, at the Valve of the Colon, being ſhut up, and about two Fingers Breadth of the Inteſtine there was grown into a hard ſolid Subſtance, below which were no Fæces. The ſmall Inteſtines were much inflamed and livid.

Cæcum

Cæcum joins the Colon, one Portion of the Circumference of both is depreſſed, and forms a large Fold on the Inſide, which advances into the Cavity of the Inteſtine. It is a little open in the Middle, and its Extremities are very thick, by reaſon of the mutual Duplicature of the Tunics of the Cæcum and Colon.

The Extremity of the Ileum is, as it were, grafted in the Opening of this Fold, and ſtrongly united to its Sides by the Adheſion of its tranſverſe Fibres, to the tranſverſe Fibres of the Cæcum and Colon.

This Union forms a pretty thick Ring, which likewiſe advances into the common Cavity of the Cæcum and Colon, where it is wrinkled, or formed into Gathers, almoſt like the inferior Extremity of the Oeſophagus, the Pylorus, or Inſide of the Anus. Its Circumference is more or leſs oval; and, by a kind of Continuity with the common Fold of the Cæcum and Colon, it forms two Productions, which MORGAGNI calls the Fræna of the Valvula Coli.

The membranous Tunic of the Extremity of the Ileum is continued on the Cæcum and Colon, without ſinking into any Fold, at the Place where the Ileum enters the Colon. The longitudinal Fibres of the muſcular Tunic ſeem here to be confounded with the neareſt circular Fibres of the Cæcum and Colon.

The interior Portion of the muſcular Tunic of the Ileum runs in between the circular Fibres of the Ileum and Colon, as into a common Fold of theſe two Inteſtines; from all which a pretty thick ſhort Portion of a fleſhy Tube is formed, which is the circular Riſing already mentioned.

The Tunica Nervoſa and Villoſa, of the Extremity of the Ileum, likewiſe enter the common Cavity of the Cæcum and Colon, and on the Edge

of the circular Riſing join the like Tunics of theſe two Inteſtines, ſo that the circular Riſing, or ſhort muſcular Tube, is covered, both on the exterior and interior Sides, by a nervous and villous Tunic; that on the Inſide being ſupplied by the Ileum, and the other by the two great Inteſtines *.

The Situation of the Extremity of the Ileum is commonly tranſverſe, and inſerted almoſt in the ſame Direction, in the common Cavity of the two Inteſtines already mentioned, but it is often a little more inclined towards the Cæcum, than to the Colon: And whereas in all other Places the Ileum is wide, and eaſily dilated; it is very narrow at its Inſertion, and its Sides more ſolid and firm.

It is chiefly in this Structure that the Mechaniſm of the Inſertion of the Ileum, in the Cæcum and Colon, conſiſts; about which Inſertion, or Opening, Authors are very much divided; ſome reckoning it a Valve, others only a Sphincter.

It is very evident, from what has been ſaid, that it is a double Machine, contrived to hinder the Return of the Excrements into the Ileum; becauſe it can produce this Effect partly as a Valve, and partly as a kind of Sphincter. The dried Preparations of this Part give a very falſe Idea of its Structure and Conformation; and the ſame Thing is to be ſaid of the Opening of the Appendicula Vermiformis into the Cæcum.

The capacious Arch of the Colon is connected, by both Extremities, to the lumbar Region, near the Kidneys, by two particular membranous Ligaments, one on the right Side, the other on the left; which are only ſmall Duplicatures of the Peritonæum, more or leſs tranſverſe.

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* The beſt Method to demonſtrate the Structure and Compoſition of this Valve, is in clear Water, and by a particular Section, while the Inteſtine is freſh, and has not been altered by any Diſeaſe.

The

The remaining Portion, which forms the two Convolutions, in Form of the Roman S, contracts below the left Kidney; being narrower there, than lower down. The Tunics of this Portion become gradually thicker and ſtronger, and likewiſe the ligamentary Membranes, which approach each other by degrees, and ſeem to increaſe in Breadth.

The Veſſels, Nerves, &c. will be found in the Deſcription of the Meſentery.

Of the RECTUM. The laſt of all the Inteſtines is named Rectum, from its Situation: For, when viewed directly forward, it appears to run down in a ſtrait Courſe from the laſt lumbar Vertebra, on the anterior Side of the Os Sacrum, all the Way to the Os Coccygis, where it ends in what is called the Anus.

This Inteſtine, properly ſpeaking, is but a true Continuation of the laſt Convolution of the Colon; and it is the Repoſitory, or common Sewer, of the whole inteſtinal Canal. It has, likewiſe, a ſpecial Connection with the Bladder, and the Parts of Generation, in both Sexes.

The Rectum, after paſſing below the laſt lumbar Vertebra to the internal Surface of the Os Sacrum, is bent poſteriorly on that concave Side to which it is connected; and, having reached the Os Coccygis, it runs, likewiſe, in the Direction of that Bone, and bends a little anteriorly, terminating beyond the Extremity of the Coccyx.

The Figure of this Inteſtine varies, according as it is full or empty. When empty, it is irregularly cylindrical, and ſinks in, by a kind of tranſverſe Folds, and, in that State, it is about three Fingers Breadth in Diameter: When full, it is wider, in Proportion to the Quantity of Fæces, Wind, or whatever elſe is contained in it; and may be extended, ſometimes, to a very great Size.

The membranous Tunic often contains a great Quantity of Fat, ſpread between it and the muſcular, and forming round the Inteſtine numerous Eminences, in lieu of the Appendices Adipoſæ of the Colon, which has been explained in the Hiſtory of the Omentum.

The muſcular or fleſhy Tunic is very thick. The longitudinal Fibres, which in the other Inteſtines are very thin, are, in this, ſtronger than the circular Fibres of the reſt; the ligamentary Membranes continue to increaſe in Breadth, and approach each other, as has been ſaid; and it is to the fleſhy Fibres of theſe Membranes that the Thickneſs of the longitudinal Fibres ſeems to be owing.

The nervous or filamentary and internal Tunics are larger here than in the other Inteſtines; and, when the Rectum is empty, they form a great Number of waving Rugæ in its Cavity, which diſappear, in Proportion as that Cavity is filled up.

The interior Tunic is very improperly termed Villoſa, and ſcarcely deſerves the Name of Papillaris, becauſe of the Smalneſs of the Corpuſcles ſpread on its Surface. It contains a great Number of ſingle or ſolitary Glands; and it is always moiſtened by a Mucus of different Conſiſtencies, diſcharged by theſe Glands or Folliculi, and perhaps by the Corpuſcles alſo.

Near the Extremity of this Inteſtine, the Rugæ or Folds become, in a Manner, longitudinal; and at laſt, towards the Circumference of the interior Margin of the Anus, they form little Bags, or ſemilunar Lacunæ, the Openings of which are turned ſuperiorly towards the Cavity of the Inteſtine: Theſe Lacunæ are ſomewhat like thoſe at the inferior Extremity of the Oeſophagus, or ſuperior Orifice of the Stomach.

Muscles of the Anus. At length the Extremity of the Rectum contracts and terminates by a narrow Orifice, called the Anus, the Sides of which are diſpoſed in cloſe Folds, or Gathers.

The Extremity of this Inteſtine has ſeveral Muſcles belonging to it; ſome of which ſurround it like Sphincters; the reſt are broad fleſhy Laminæ inſerted into it; which, being likewiſe fixed to other Parts, ſuſtain it in its natural Situation, and reſtore it to that Situation when diſturbed by the Force neceſſary for the Expulſion of the Fæces. Theſe latter Muſcles are termed Levatores Ani; the firſt go by the general Name of Sphincters.

Theſe Sphincters are three in Number: One inteſtinal, or orbicular; and two cutaneous, or oval; one of which is large, ſuperior, and internal; the other ſmall, inferior, and external.

The inteſtinal or orbicular Sphincter of the Anus conſiſts merely in an Augmentation of the inferior Portion of the fleſhy Fibres of the Extremity of the Rectum.

There are two Ligaments which it is proper to deſcribe here; viz. the Ligamentum Cutaneum Oſſis Coccygis, and the Ligamentum Pubis Interoſſeum.

The cutaneous Ligament goes out anteriorly from the Extremity of the Os Coccygis. It is very ſlender, and divides into two Portions at the Orifice of the Anus, which run into the Membrana Adipoſa, and are inſerted in the Skin, on each Side of the Anus, by a kind of Expanſion; and, continuing to divaricate, they are loſt on the two Sides of the Peritonæum.

The interoſſeous Ligament of the Oſſa Pubis is a very ſtrong triangular Membrane, fixed, by its two Extremities, to the inferior Rami of theſe Bones, all the Way up to their common Symphyſis. The third Extremity, which is the inferior one,

one, is looſe; and this whole Membrane, the Middle of which is perforated by a particular Foramen, is ſtretched very tight between the two Bones, and under their cartilaginous Arch, to which it adheres very cloſely.

At the inferior Part of this interoſſeous Ligament, along its whole inferior or looſe Extremity, lies a digaſtric Muſcle*, fixed, by its two Ends, in the Rami of the Oſſa Pubis; its middle Tendon lying on the Middle of the Extremity of the Ligament.

The cutaneous Sphincters have each an anterior and poſterior Inſertion, ending both Ways in a kind of Point, and comprehending the Orifice of the Anus between their middle Portions.

They are diſtinguiſhed from each other by their Situation, Size, and a kind of white cellular Line. The greateſt of the two appears to be double, and the ſmalleſt lies neareſt the Skin, and adheres cloſely to it.

They are inſerted, poſteriorly, partly in the Apex of the Os Coccygis, and partly in the contiguous Portion of the cutaneous Ligament of that Bone; anteriorly, their chief Inſertion is in the middle Tendon of the Tranſverſalis Urethræ; and they have likewiſe ſome Connections to other Muſcles of the Urethra.

The Levatores Ani are broad, thin, muſcular Portions, fixed, by one Extremity of their fleſhy Fibres, round the concave Side of the inferior Portion of the Pelvis, from the Symphyſis of the Oſſa Pubis beyond the Spine of the Iſchium. The other Extremity of theſe Fibres runs down on each

* The Deſcription of that Muſcle does not belong to this Place; and is mentioned here, only becauſe of the Relation it bears to the cutaneous Sphincters of the Anus. It is called, by ſome, Muſculus Tranſverſalis Urethræ; by others, Muſculus Triangularis.

Side

Side behind, and under the Curvature of the End of the Rectum, where they meet together, and unite, from the Baſis of the Os Coccygis, all the Way to the Margin of the Anus.

By their ſuperior Inſertions theſe Portions are, on each Side of the Pelvis, divided into three Claſſes; an anterior, middle, and poſterior Claſs.

The two anterior Claſſes reach from about the Middle of the Symphyſis of the Oſſa Pubis to the ſuperior Border of the Foramina Ovalia of the Pelvis; the middle Claſſes continue the ſame Courſe immediately above the Inſertion of the Obturator Internus, on the Oſſa Iſchium, and a little on the Oſſa Ileum: The poſterior Claſſes are ſpread on the interior Sides of the Oſſa Iſchium to the ſpinal Apophyſes of theſe Bones, and even a little beyond theſe, on the Ligamenta Sacro-Sciatica.

The anterior Portions are, in their Paſſage, connected to the proſtrate Glands, to the Neck of the Bladder, and to the Bulb of the Urethra; as ſhall be demonſtrated, in the Deſcription of thoſe Parts: And they ſometimes ſend Fibres to the Muſculus Tranſverſalis Urethræ above mentioned.

The Fibres of all theſe Portions, having, by their ſuperior Inſertions, formed this ample Circumference, run down obliquely from the anterior to the poſterior, contracting in Breadth, and approaching each other in manner of truncated Radii; and behind, and under the Extremity of the Rectum, they form a digaſtric Muſcle, ſomewhat like the Mylo-Hyoïdæus; which terminates the Pelvis, and forms the inferior Cavity of the Abdomen, as the Diaphragm does that of the ſuperior.

It is proper here to obſerve, that the Muſcles of the Os Coccygis may be looked upon as Aſſiſtants to the Levatores.

We

We ought likewiſe to remark, that the Margin of the Anus is by the Union of the Cutis and Epidermis.

Observations.

The inferior End of the Rectum is the Seat of the true Fiſtula in Ano, which uſually runs between the muſcular Coat and the interior one. It is cured by opening it, the whole Length, into the Cavity of the Gut: It is yet better, if it can be done, to extirpate all that is fiſtulous and ſchirrous; for that is a ſure Way to make one Operation perfect the Cure.

The other Kind of Fiſtula, improperly ſo called, is an Abſceſs running round the Outſide of the Sphincter, in the Shape of an Horſe-ſhoe, being a perfect Circle, except at the Place where this Muſcle unites with thoſe of the Penis. This is beſt cured by opening and removing Part of the outer Skin. The firſt of theſe Caſes happens oftenest in full Habits, proceeding frequently from the Piles; the laſt is generally a critical Diſcharge, and one of Nature's laſt Efforts in conſumptive and ſcorbutic Habits of Body. The Inverſion and ſliding down of this Gut is called Prolapſus Ani, a Diſeaſe common in Children, eſpecially thoſe who are afflicted with the Stone, and of not much Conſequence. In Men it is more rare, and more dangerous; being generally attended with a Flux of Humours. This Caſe I have cured, by taking away a Piece of the prolapſed Gut with a Cauſtic, lengthways of the Gut. The Wound diſcharged the Flux of Humours; upon which the Gut was eaſily reduced; and cicatrizing, in that State, it never more fell down.

I have ſeen a Caſe, where a bold unthinking Surgeon having cut off the prolapſed Part, the Cicatrix was ſo hard and contracted, that the Patient

tient could never after go to Stool without a Clyſter, and then not without great Miſery.

Oftentimes the Piles occaſion large Tumors at the lower End of this Gut. Theſe are always beſt extirpated by Ligature: For if they are cut, they will ſometimes bleed exceſſively; and it is not an eaſy Matter to apply any Thing to ſtop a Flux of Blood in that Part. CHESELDEN's * Anatomy.

A Woman, in the fiftieth Year of her Age, had a Rupture at her Navel, which continued till the ſeventy-third Year; when, after a Fit of the Cholic, it mortified: And ſhe being preſently after taken with a Vomiting, it burſt. I went to her, and found her in this Condition, with about Twenty-ſix Inches and a Half of the Hanging-out mortified. I took away what was mortified, and left the End of the ſound Gut hanging out at the Navel, to which it afterwards adhered. She recovered, and lived many Years after; voiding the Excrements through the Inteſtine at the Navel. And though the Ulcer was ſo large, after the Mortification ſeparated, that the Breadth of two Guts was ſeen; yet ſhe never, at any Time, protruded out at the Wound, though ſhe was taken out of her Bed, and ſat up every Day. Ibid.

Diſorders the INTESTINES are moſt ſubject to.

The Inteſtines, eſpecially the ſmall ones, are ſubject to acute Inflammations in their Membranes. This Diſorder happens by the common Cauſes of an Inflammation conveyed to them: Either (for inſtance) by the acrid Subſtance of Liquors, Aliments, Spices, Pickles, Medicines, or

* If I did not know that Mr. CHESELDEN had been a Surgeon, I ſhould have thought that this had been the Language of a Butcher, rather than that of an Anatomiſt.

Poiſons,

Poiſons, received from the Stomach, and conveyed from thence to the inteſtinal Valvules. This Diſeaſe may alſo be produced by an acrid, putrid, fœtid, purulent, ichorous, gangrenous, bilious Matter, &c. conveyed from the Oeſophagus, Stomach, Liver, Spleen, Pancreas, and Omentum, to the Inteſtines; where it remains, and corrodes them. And, laſtly, an inteſtinal Inflammation may be cauſed by violent previous Convulſions; which create Flatulencies, and ſtop the Motion of the Fluids; which cauſe an Inflammation. This Diſorder contracts the Inteſtines, cloſes up their Cavities, and obſtructs the Paſſage of what ſhould be conveyed to them. Thence ariſe acute, burning, and fixed Pains; excites violent Convulſions, when the inflamed Part is irritated by what is conveyed to it; renders the Patient coſtive, excites Vomiting, if the inteſtinal Portion is inflamed near the Pylorus, or by the inferior Portion of the Inteſtines; cauſes painful Flatulencies, acute Gripes accompanied with Rumblings, the Iliac Paſſion, the Diſeaſe called Volvulus, an Abſceſs, Gangrene, Scirrus, Cancer, vehement acute Fever, exceſſive Weakneſs, and, oftentimes, ſudden Death.

As long as the Diſorder continues in its inflammatory State, it is, by ignorant and unſkilful Perſons, taken for what the Vulgar call the Twiſting of the Guts, which they aſcribe to cold Flatulencies, and therefore preſcribe hot Medicines; a Practice which often proves fatal to the Patient *.

But a genuine Inflammation of the Inteſtines is known by its concomitant, continual, acute Fever,

* An Inſtance of this I ſaw laſt Winter, when I was deſired to open the Body of a Male Child about ſeven Months old, who, for ſome Time, could not keep any Thing in his Stomach, nor would any

Fever, intenſe Thirſt, exceſſive Heat, a hard Pulſe, a burning Pain, high-coloured Urine, and the Induction of a ſudden Weakneſs.

When an Inflammation ſeizes the Flexure of the Colon, the Diſorder is termed the Colic; but if ſeizes the Extremity of the Rectum, it is generally taken for the Blind Hæmorrhoids: In which Caſe, its moſt happy Termination is by a mild, bloody, and bilious Dyſentery.

As ſoon as we ſuſpect an inteſtinal Inflammation, in its firſt Stage, we ſhould order Veneſection pretty freely, as in a Pleuriſy; then antiphogiſtic Clyſters, repeated three or four Times a Day, or oftener; drinking, frequently, laxitive diluting Liquors.

From what has been obſerved, it is ſufficiently obvious, why, in Practice, ſuch violent, fixed, obſtinate, intolerable, and unſurmountable Pains are perceived in the Oeſophagus, the Orifice of the Stomach, the Liver, Spleen, Pancreas, Ileum, and the Colon; as alſo, how various and ſurpriſing a Diſorder a Dyſentery is, in every Reſpect! How improperly and unjuſtly, in Diſeaſes of this Kind, a certain hectic Acrimony of Humours is accuſed, and prejudicial Medicines exhibited, in order to remove this ſuppoſed Acrimony? How cautious one ought to be, in exhibiting Purgatives, in exceſſive Pains of theſe Parts! What is the Nature of that

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any Thing paſs through his Inteſtines, notwithſtanding all proper Medicines were adminiſtered. On examining the Inteſtines, I found that Part of the Colon, which lies under the Stomach, bent down quite acroſs the Duodenum, and the Cæcum, with a Portion of the Ileum, introſuſcepted about nine Inches into the Colon; which I, with ſome Difficulty, diſinvolved; and found that Part of the Ileum, which opens into the Cæcum, callous, and almoſt mortified: A fuller Account of which, I have given to the ROYAL SOCIETY, at the ſame Time that I ſhewed the Inteſtines, which I preſerved: It being the moſt extraordinary Caſe, of this Kind, that ever was met with.

incu-

incurable Hypercatharſis, which, in ſome Patients, frequently ſucceeds the Adminiſtration of Purgatives! How various are the Remedies and Meaſures which are requiſite for the Cure of Dyſenteries! How vain, fallacious, and deſtructive, it is to preſcribe one Medicine as proper in all their various Conditions and Natures! Or, in ſhort, a general Method of Cure. See BOERHAAVE's Aphoriſm.

N. B. I do not take Notice here, of the Worms which the Inteſtines are very much ſubject to, eſpecially in young Subjects.

LEC-

LECTURE IV.

Of the MESENTERIUM, MESOCOLON, SANGUIFEROUS VESSELS, and NERVES, of the INTESTINES.

THE Inteſtines are connected by a membranous Lamina, which prevents the inteſtinal Convolutions from being intangled with each other, and twiſted or compreſſed, in all their different Ways of collecting; and yet have a gentle floating, but limited Motion, in their natural State.

This membranous Lamina is named, by the Antients, Meſentery, as being, in ſome meaſure, in the Middle of the Inteſtines.

It is divided into two Portions; one of which, being very broad, and very much plaited, connects the ſmall Inteſtines; the other, which is long and incurvated, does the ſame Office to the great Inteſtines.

Theſe two Portions are, in Reality, only one and the ſame Continuation of the membranous Lamina of the Duplicature of the Peritonæum; and they are diſtinguiſhed only by their Breadth.

Taken both together, they form a kind of ſpiral Roll, more or leſs plaited in its Circumference. The firſt Portion has retained the Name of Meſentery; the other is termed Meſocolon.

Structure of the MESENTERY, &c.

The Meſentery begins at the laſt Incurvation of the Duodenum, and runs obliquely, from left to right, along the lumbar Vertebræ: In this Space, the membranous Portion of the Peritonæum produces a Duplicature by two Elongations, or particular Laminæ, applied to each other; and thus forms the Meſentery.

It is narrow at its ſuperior and inferior Parts, but chiefly at the ſuperior; the middle Portion is very broad, and the Edge of it next to the Inteſtines is every-where very much plaited. The Plaits, or Folds, are only waving Inflections, ſuch as may be obſerved on the Edge of a Piece of Shamoy, which has often been drawn through the Fingers. They make this Edge of the Meſentery very long, and run through about a third Part of its Breadth.

The two Laminæ are connected by a cellular Subſtance, which inveſts the Glands, Veſſels, and Nerves; and, in ſome Subjects, it has a great Quantity of Fat, which keeps the two Laminæ at ſome Diſtance from each other.

Along the whole Circumference of the Meſentery the two Laminæ are naturally ſeparated, to involute the Circumference of the ſmall Inteſtines, which they inveſt by their Union, or rather reciprocal Continuation on the great Curvature of that Canal, and carry it as in a Scarf or Sling. This is what forms the external or membranous Tunic of the Inteſtines.

The Meſocolon is the Continuation of the Meſentery; which, having reached the Extremity of the Ileum, contracts, and aſſumes this Name. At this Place the particular Lamina, which is turned to the right Side, forms a ſmall tranſverſe Fold, called Ligamentum Coli Dextrum.

After-

Afterwards the Meſocolon aſcends towards the right Kidney, where it ſeems to be loſt by the immediate Adheſion of the Colon to that Kidney, and to the firſt Incurvation of the Duodenum; then it appears again, and, increaſing in Breadth, continues its Courſe almoſt tranſverſly under the Liver, Stomach, and Spleen, where it begins to turn downwards under the left Hypochondrium, towards the Kidney on the ſame Side.

Through this whole Courſe, the Meſocolon extends in Breadth, and forms nearly a tranſverſe ſemicircular Plane, very little plaited at its great Circumference: By this Circumference, or Edge, it is connected to the Colon, and hides that ligamentary Membrane of this Inteſtine which runs along its ſmall Curvature.

By its ſhort or ſmall Edge it forms the triangular Caſe of the Duodenum; and, by its great Edge, the external Tunic of the Colon, in the ſame Manner as the Meſentery does that of the ſmall Inteſtines.

As it paſſes under the great Extremity of the Stomach, it adheres a little to the inferior Portion of that Extremity, as the Diaphragm does to the ſuperior: Having got below the left Kidney, it contracts, and forms another tranſverſe Fold called Ligamentum Coli Siniſtrum; afterwards it expands again, but not ſo much as in the ſuperior Part, and runs down, on the left Pſoas Muſcle, towards the laſt lumbar Vertebra: This deſcending Portion is fixed to the Convolutions of the Colon, in the ſame Manner as the ſuperior Portion is to the Arch of that Inteſtine.

The Inteſtinum Rectum is likewiſe inveſted by a particular Production of the Peritonæum, commonly called by the barbarous Name of Meſo-Rectum: This Production is very narrow; and about the Middle of the anterior Side of the

Rectum, it forms a tranſverſe ſemicircular Fold, which appears when the Inteſtine is empty, but is loſt when it is filled.

Sanguiferous Vessels of the Intestines.

The Duodenum has commonly a particular Artery, called Duodenalis, or Inteſtinalis, which comes indifferently from the Stomachica Coronaria, Pylorica, Gaſtrica Major, or Hepatica: It has likewiſe ſeveral diſtinct Ramifications from theſe Trunks, and from the Meſenterica Superior and Splenica; which Ramifications communicate with each other.

The Arteria Duodenalis, and the other additional ſmall Arteries, form a vaſcular Texture round the muſcular Coat of the Inteſtine, which ſends out a great Number of Capillaries both towards the exterior and interior Sides, which make the whole Inteſtine look of a red Colour.

The Veins of the Duodenum are Rami of the Vena Porta; and the Diſtribution and Denomination thereof is pretty much the ſame with that of the Arteries; only they communicate more with each other than the Arteries, and alſo with the great Hæmorrhoïdal Vein.

The venal Ramifications form, round the Duodenum, a reticular Texture, like that of the Arteries; and the ſame kind of vaſcular Texture is more or leſs to be found on all the other Inteſtines.

The Arteries of the Jejunum come chiefly from the Meſenterica Superior, and ſome from the aſcending Branch of the Meſenterica Inferior: The Veins are, for the moſt part, Branches of the Meſaraica Major, and the reſt come from the Splenica and Meſaraica Minor, or Hæmorrhoïdalis Interna.

The

The principal ſubaltern Trunks of theſe Arteries and Veins accompany each other through the cellular Subſtance, between the Laminæ of the Meſentery; are diſtributed by Branches or Rami, and form the Meſhes, Lozenges, and Arches, mentioned in the Deſcription of the Arteries and Veins: The laſt of theſe Arteries and Lozenges, or thoſe next to the Inteſtine, produce two ſmall vaſcular Laminæ, which ſeparate from each other very diſtinctly, and ſurround the inteſtinal Canal like a Net.

The Blood-Veſſels of the Ileum come from the ſame Source with thoſe of the Jejunum, as has been ſaid in the Hiſtory of the Arteries and Veins: And it ought to be obſerved, concerning both theſe Veſſels and thoſe of the Jejunum, that, in their whole Courſe through the Meſentery, they give Ramifications to the Glands, Laminæ, and cellular Subſtance of the Meſentery; and alſo, that there is a kind of Communication between ſeveral ſmall meſaraic Veins and the capillary Rami of the Venæ Lumbares and Spermaticæ.

The Arteries of the Cæcum and Appendicula Vermiformis are Ramifications of the laſt Branch, from the convex Side of the Meſenterica Superior; and they have likewiſe ſome ſmall ones from the ſecond and third Rami, when both are found. The Veins of theſe two Parts are Ramifications of the Meſaraica Major; and one of theſe Rami is, by RIOLAN, termed Vena Cæcalis.

The ſtreight Portion of the Arch of the Colon, or that which is an immediate Continuation of the Cæcum, is ſupplied with Arteries by the ſecond Branch, which comes from the concave Side of the Meſenterica Superior; and likewiſe a little by the third, when there is a third.

The ſuperior or middle Portion of the Arch of the Colon is furniſhed, by the firſt Branch, from

the ſame Side of the Meſenterica Superior, which, by a Bifurcation, communicates on both Hands with the other Portions of the Arch of the Colon.

The left Portion of this Arch derives its Arteries partly from the firſt Branch of the ſame Meſenterica, and partly from that of the Meſenterica Inferior; which two Branches form the celebrated Communication, or common Arch of the two Meſentericæ.

By means of this Communication, or Continuation, in caſe one Artery ſhould be obſtructed or compreſſed, the other will furniſh Blood to all the Branches below the Place of the Obſtruction. The ſecond Branch of the Meſenterica Inferior gives likewiſe ſmall Arteries to the left Extremity of the Colon. The deſcending Convolutions of the Colon, which repreſent a Roman S, are ſupplied by the other Branches of the Meſenterica Inferior, the laſt of which forms the Hæmorrhoïdalis Interna.

The Veins of all theſe Portions of the Colon are Branches and Ramifications of the Vena Portæ Ventralis, and principally of the ſubaltern Trunks, the Meſaraica Major and Meſaraica Minor, or Hæmorrhoïdalis Interna. The Diſtribution of theſe Branches and Ramifications is, in ſome meaſure, the ſame with that of the Arteries; as may be ſeen in the Deſcription of the Veins.

The Arteries of the Rectum are furniſhed by the Hæmorrhoïdalis Interna, the laſt Branch of the Meſenterica Inferior, which communicates with the Hypogaſtrica, and particularly with the Hæmorrhoïdalis Externa, a Production of one of theſe Arteries.

The Veins of the Rectum are Ramifications of the laſt Branches of the Meſaraica Minor, or Hæmorrhoidalis Interna; and they communicate with the Hæmorrhoïdales Externæ, which are Rami of one

one of the Hypogaſtricæ: They communicate, likewiſe, with the capillary Ramifications of the other Hypogaſtric Veins, which go to the internal Parts of Generation of both Sexes.

It is here to be obſerved in general, that there is a ſucceſſive Continuation, more or leſs ſimple or multiplied, between all the Arteries of the Inteſtinal Canal, and likewiſe between all the Veins; and alſo, that the Veins are here thinner and more capacious than the Arteries, in a greater Proportion than in the other Parts of the Body.

Nerves of the Intestines.

The Nerves of the Duodenum are, the middle Plexus of the ſemilunar Ganglion, and ſome Filaments of the Plexus Stomachicus and Hepaticus.

The Nerves of the Jejunum, Ileum, and meſenteric Glands, are, the Plexus Meſentericus Superior, the poſterior Meſenteric Faſciculi, and the Plexus Meſentericus Inferior.

The Nerves of the Cæcum are, the poſterior Meſenteric Faſciculi, or Plexus, and the Plexus Meſentericus Inferior.

The Nerves of the Arch of the Colon are, the ſame Faſciculi, and the two Plexus Meſenterici.

The Nerves of the laſt Convolutions of the Colon are, the poſterior Meſenteric Faſciculi, and the Plexus Meſentericus Inferior, and Sub-Meſentericus.

The Nerves of the Rectum are, the Plexus Meſentericus Inferior, Plexus Sub-Meſentericus, or Hypogaſtricus, and the two Ganglions of that Plexus.

The Nerves of the Anus, and of its Muſcles, are, the Ganglions of the Plexus Sub-Meſentericus, the inferior Rope of both the Sympathetici Max-

imi, and the common Arch of the Extremities of both Branches.

The Mesenteric Glands, Lymphatic and Lacteal Vessels.

Between the Laminæ of the Meſentery, a great Number of Glands lies ſcattered through the cellular Subſtance. In the natural State theſe Glands are ſomewhat of the Figure of Lentils, or little round Beans; ſome of them being orbicular, others oval, but all of them a little flatted; and in corpulent Subjects we find them ſurrounded with Fat.

Theſe Glands are of the Number of thoſe which Anatomiſts call Glandulæ Conglobatæ, the Structure of which is not, as yet, ſufficiently known. They ſeem to be of a cellular Subſtance, ſurrounded by a very fine Membrane, or Tunic; on which, by the Help of a Microſcope, may be ſeen an Intertexture of particular Filaments, which Malpighi believed to be fleſhy Fibres.

The niceſt anatomical Injections have not hitherto given us any Satisfaction about theſe Particulars: For though they are made with all poſſible Care, they always fill the folliculous Texture of theſe Glands. And though, by means of theſe Injections, we may diſcover a great many Veſſels, which were before inviſible; we are not a Whit the nearer in our Purpoſe; becauſe we cannot, by this Method, diſtinguiſh the ſecretory, excretory, and ſanguiferous Veſſels, from each other.

Lymphatic Vessels.

Beſides the ſanguiferous Veſſels, which are diſtributed, in a reticular Manner, in the meſenteric Glands, and beſides many nervous Filaments ſpread through

through them; we diſcover an infinite Number of ſmall Veſſels, of another Kind, running from Gland to Gland.

Theſe Veſſels are extremely thin, and tranſparent; and furniſhed on the Inſide with numerous Valves, which appear on the external like little ſmall Knots, very near each other. They emerge from each Gland, by Ramifications, as by ſo many Roots; and, having formed a ſmall Trunk, they are again divided, and enter ſome adjacent Gland, by the ſame kind of Ramifications which they went out from the former.

They are termed lymphatic Veſſels, becauſe, for the moſt part, they contain a very limpid, though mucilaginous Serum, called Lympha by Anatomiſts.

But as they have likewiſe been obſerved to be filled with a milky Fluid called Chyle, they have been called Vaſa Chylifera, or Venæ Lacteæ. They have the Name of Veins, becauſe their Valves are diſpoſed like thoſe of the ſanguiferous, and becauſe the Fluid, which they contain, runs from ſmaller into larger Tubes.

Diviſion of the Lacteal Veſſels.

Dr. Winslow commonly divided the lacteal Veſſels of the human Body into three Claſſes; but ſometimes into four.

They derive their Origin from the Tunica Villoſa of the Inteſtines, and chiefly from that of the ſmall Inteſtines, by a great Number of capillary Roots, as has been already ſaid.

From theſe Roots there ariſes, between the Tunic of the Inteſtines, a kind of Rete Mirabile, which ſurrounds almoſt the whole Circumference of the inteſtinal Canal between the muſcular and external Tunic.

This

This reticular Texture of the lacteal Veſſels, keeps cloſe to the external Tunic, and leaves the Canal, along with it, on the Side of the Meſentery, where it forms two Planes of Ramifications, plainly diſtinguiſhed from each other by the cellular Subſtance, and adhering cloſely to the Inſide of the two Membranes of the Meſentery. In this ſeparate State they run on the Laminæ of the Meſentery, as far as the firſt meſenteric Glands, where they unite again in one Plane. All this is reckoned the firſt Claſs of Lacteals.

The ſecond. After this Union, the lacteal Veſſels are diſtributed almoſt uniformly, through the whole Extent of the Meſentery, from its Circumference to its Origin, or Adheſion to the dorſal Vertebræ, between the meſenteric Glands, which they join, in the Manner already ſaid, and form frequent Anaſtomoſes, or Communications.

Having paſſed through the Meſentery, in this Manner, the Ramifications begin to unite, as they approach the Spina Dorſi, and conſequently their Number is leſſened, and their Size increaſed; and, having paſſed the laſt meſenteric Glands, they terminate about the Middle of the Adheſion of the Meſocolon, in ſmall common Trunks, which receive a great Number of lymphatic Veſſels from the Glandulæ Lumbares, and others below theſe.

A fourth Claſs may be made of the lacteal Veſſels of the great Inteſtines; of which ſeveral, full of Chyle, have been demonſtrated to the Royal Academy at Paris, in a human Colon.

The lacteal Veſſels are not always apparent in human Subjects; but we may ſee them in thoſe who die either a violent or ſudden Death, ſoon after a Meal; and they remain viſible, even in the Inteſtines, for a long Time after Death, when a great

great Number of the meſenteric Glands have become ſcirrous, eſpecially in Children, and thoſe who die of ſcrophulous Diſorders.

Receptaculum Chyli.

The lacteal Veſſels of the third Claſs, or thoſe which lie between the meſenteric Glands and middle Adheſion of the Meſocolon to the Spina Dorſi, run down on the Body of the inferior Aorta, between the Extremities of the ſmall Muſcle of the Diaphragm, and terminate in a kind of Ciſtern, called, by ſome, Receptaculum Chyli, by others, Receptaculum Pecqueti; from Pecquet, a Phyſician at Dieppe; who firſt demonſtrated, by inconteſtable Experiments, in the Year 1651, this Receptacle; which had been, long before, diſcovered by Eustachius*.

The Thoracic Duct, ſo named from its Courſe, is generally ſingle; or if it be double, for ſome Part of its Courſe, it ſoon after unites into one again, which goes behind the Pleura; aſcending in an inflected Courſe, it receives, in its Way, the lymphatic Veſſels of the Stomach, Oeſophagus, and Lungs; and paſſes through the dorſal Glands, of the many which are incumbent on and about it. It is generally cylindrical, and often forms Inſulation, by dividing into two, or more; after which it unites into one again, eſpecially in its ſuperior Part. It has but a few Valves, which are not very conſpicuous.

* Itaque in illis animantibus (Scel. Equis) ab hoc ipſo in ſigni trunco ſiniſtro Juguli, qua poſterior ſedes radicis Vena Jugularis ſpectat, magna quædam propago germinat, quæ præterquam quod in ejus origine Oſteolum ſemicirculare habet, eſt etiam alba & aquei Humoris plena; nec longe ab ortu in duas partes ſcinditur, paulo poſt rurſus cocuntes in unam, quæ nullos ramos diffundens, juxta ſiniſtrum Vertebrarum latus, quo loco latior effecta, magnaque Arteriam circumplan, obſcuriſſimum finam, mihique non bene perceptum, obtinet. Vid. De Vena ſine pari.

About

About the fifth dorſal Vertebra it generally croſſes behind the Oeſophagus, and then aſcends along the right Side of the Thorax, behind the ſubclavian Veins, till it has arrived near the ſix cervical Vertebræ: There, bending down, it often divides into two, and each deſcending Branch dilates into a Sort of Veſicle which enters, either with diſtinct or united Openings, into the Juncture of the Subclavian and Jugular Vein internally, by an oblique Courſe, from the ſuperior, poſterior, and lateral Part, inferiorly towards the left and anterior; advancing, either with one or two Branches, under the Subclavian, on the exterior Side of its Juncture with the Jugular. It has no true Valve placed before it, but excludes the Entrance of the Blood, only the perpendicular Weight of its Contents; but the oblique Inſertion of it repreſents a ſort of Wrinkle. It is rarely otherways diſpoſed, and very ſeldom ſplit in two, longitudinally, for diſtinct Inſertions into the Subclavian; and yet more uncommonly apt to ſend off a Branch into the Vena Azygos. Near its Inſertion it receives the Opening of a large lymphatic Veſſel tranſverſly from the Arm, and others deſcending from the Head, in one or more Trunks.

The Function of the Intestines.

From the exhaling Arteries diſtils a thin aqueous Liquor into the Cavity of the Inteſtine, not at all acid, but like the ſtomachic Juice; the Quantity of which may be computed from the large Extent or Number of the excretory Orifices, and from the Section of the excretory Artery, larger than which we ſee elſewhere of the Body: Add to this, the Laxity of the Parts, perpetually kept warm and moiſt, and the copious Diarrhæa or watery Diſcharge which often follows the Uſe of Cathartics. But that the Mucus ariſing from the Pores

or

or Cells of the Inteſtines ſerves to lubricate and defend the internal Surface of the villous Membrane, and to preſerve the Nerves from the Vehemency of too acrid or pungent Particles.

Hence we ſee, that it is more copious at the Beginning of the larger Inteſtines; becauſe there the Maſs of Aliment begins to be more feculent, acrid, and tenacious.

The Mixture of this Liquor with the Pulp-like Maſs of the Aliment, together with the Bile and pancreatic Juice, is made by the Motion of the ſurrounding Muſcles of the Abdomen, but more eſpecially by the periſtaltic Motion, which is more particularly ſtrong and obvious in the ſmall Inteſtines. For any Part of the Inteſtines, irritated by Flatus, or any ſharp Humour, contracts itſelf, even after Death, with a conſiderable Force: This contracting Motion is made in various Parts of the Inteſtines, either ſucceſſively, or at the ſame Time, wherever the Flatus or Aliment excite a Stimulus; and this, without obſerving any certain Order, with a Sort of wonderful alternate Creeping and Revolution of the Inteſtines, as appears eaſily in diſſecting living Animals, and ſometimes, by unhappy Accidents, in the human Species: As in Ruptures, Wounds of the Abdomen, &c. (this Creeping of the Inteſtines, for the Facility and Duration, is equal, if not ſuperior, to the Irritability of the Heart itſelf.) Among ſo many Inflections, the Weight of the Aliment is but of little Force: It eaſily aſcends or deſcends through the irritated Inteſtine, which thus empties itſelf. From whence the Uſe of the periſtaltic Motion is intelligible, by which the Pulp of the alimentary Subſtance is oftener or longer applied, with a gentle Force, to the Triture of the Inteſtine, to the exhaling dilutent Liquor, and to the Orifices of the abſorbing Veſſels. But all the Contents of

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the Inteſtines are determined downwards to the Colon; becauſe the Stimulus begins above, from the inferior Orifice of the Stomach; and, by the Succeſſion of new Chyle repeating it above the Contraction, it deſcends, when there is no Reſiſtance made to it, into the inferior Part of the Ileum, at its Opening into the Colon: Therein the looſe Part of this Inteſtine readily receives what is preſſed into it by the Contraction from above, and as eaſily exonerates itſelf into a large unactive Cæcum; from whence it is again repelled upwards, and, in Part, urged on by the Preſſure of the ſucceeding Aliments. Some Perſons obſerve, that this Motion is ſtronger in the inferior than the ſuperior Part.

The inteſtinal Fæces, therefore, retained in the Bottom of the Cæcum, grow dry there by the Abſorption of moiſt Vapours, ſo as to be capable of receiving a Figure from the round contracted Parts of the Colon; by which being ſuſtained, as on a Stair-caſe, they aſcend from the Cæcum, elevated by the long Ligaments, which end in the Vermiformis.

Here we more eaſily perceive the Manner in which the Fæces are propelled by the muſcular Contractions of the circular Fibres, whoſe Contractions are leſs conſpicuous in the ſmall Inteſtines. The longitudinal Fibres of the Inteſtine being attached to the contracted Parts, as fixed Points, draw up and dilate the inferior Parts of the Inteſtine; then the next inteſtinal Portions, to which the Fæces are brought, being irritated, and contracted, in like manner, are, immediately after, drawn together by the circular longitudinal Fibres, by a ſucceſſive Repetition, till the Fæces have intirely paſſed through the large Inteſtine. This periſtaltic Motion is very conſpicuous in Wounds of the Abdomen, and is ocularly demonſtrable in the comparative Anatomy of Brutes.

Whilſt the Fæces or Excrements aſcend, by means of the Rugæ or Valves of the Ileum, the Gravity of them depreſſes the inferior Valve to the left Side, which draws back the Ligament, common to each Valve, in ſuch a Manner, as to compreſs and exactly cloſe up the ſuperior Valve inferiorly, that nothing may go back into the Ileum, which might eaſily happen in a fluid State of the Fæces: From thence they continue the progreſſive Motion ſlowly through the whole Track, and repeated Flexures of the Colon, ſo as to retain the Excrements; till, at length, the Excrements arrive at the Rectum, which is inflected firſt a little poſteriorly, and then anteriorly, into a broad depreſſed Figure, at firſt deſcending contiguous to, and afterwards ſpread under the Bladder in Men, or Vagina in Women, but contracted more in the former than the latter: Therefore, whenever the Fæces are collected to a conſiderable Quantity in the Rectum, ſo as to become troubleſome, either by their Weight, Irritation, or Acrimony, which excite an Uneaſineſs through the adjacent Viſcera, and are then urged down to the Anus, by a voluntary Preſſure, and the Force of the incumbent Diaphragm: For, by this Means, the abdominal Viſcera, when the Reſiſtance of the Anus is overcome, the compreſſing Forces of the Diaphragm abate, and the Fæces continue to diſcharge from the Body, urged only by the periſtaltic Motion itſelf. After the Excrements are expelled, the Inteſtine is drawn back or up again, into its natural Situation, by means of its longitudinal muſcular Fibres; after which, the Opening of the Anus itſelf is cloſely contracted by the ſphincter Muſcles, as before.

LEC.

LECTURE V.

Of Hunger, Thirst, Food, and Drink.

WE see that the Creator has given to Man the two faithful Guards of Pleasure and Pain for his Preservation; one to avert Evil, the other to invite him to useful Actions. From hence we are informed, that the taking of Aliments is an Action necessary and useful to our Support.

For since every Day there is a great Quantity wasted from the Body, by a Dissolution of its true Substance, thrown off by Perspiration, and other Discharges; a Reparation of the said Loss is absolutely necessary: And this is more especially demanded from the Aliment, by the Nature of the Blood itself, strongly inclined to a sharp, saline, lixivial Quality; and to a putrid acrimonious State, to which it is continually sollicited, and approaches from the putrescent Disposition of all the more stagnant Humours of the Animal, promoted by the incessant and natural Motion of the Heart and Arteries, with a perpetual Heat. Moreover, the Disposition of the Blood to be coagulated, continually losing a great Part of its diluting Water, by insensible Perspiration, calls strenuously for a Recruit of the watery Element, in the Way of Drink, by which its cohesive Globules are separated from each other, and hindered from running together into a consistent Mass.

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Theſe Truths are proved not only from their Cauſes, but likewiſe by the Effects and Appearances which they exhibit in Men, and other Animals, killed by Hunger: For, in theſe, we commonly obſerve a ſharp ſtinking Breath, a Looſeneſs of the Teeth, from the diſſolving Acrimony of the Juices; violent Pains in the Stomach, a ſharp Fever, and even a true Madneſs. All theſe Diſorders ariſe ſooner and ſtronger, as the Perſon is more robuſt, and more violently exerciſed with Motion of Body; but they enſue very ſlowly in phlegmatic People, who are inactive, perſpire little, and put the Blood into no great Motion.

The freſh Chyle, compoſed, for the moſt part, out of the aceſcent Claſs of Vegetables, and of a Conſiſtence always thinner than that of the Blood itſelf, being received into its Torrent of Circulation, ſerves to temperate the putreſcent Acrimony, to dilute or leſſen the Coagulation threatened, and reduce the whole Maſs from a ſharp ſaline, to the mild albuminous Nature, which is proper to healthy Blood: And, finally, the Chyle, but more eſpecially that derived from the Fleſh of Animals, being repleniſhed with gelatinous Lymph, ſerves to repair the Conſumption, or Waſte, which is made from the Body itſelf, to the Vacuities of whoſe broken Solids it is applied, by the Cauſes before mentioned. But the Drink chiefly dilutes the coheſive or grumous Inclination of the Blood, hinders its putreſcent Acrimony, and carries off, by the Emunctories, ſuch Particles as are already putrid; and hence it is, that a Perſon may live, for a long Time, without ſolid Food, if he be but ſupplied with Drink, or even Water.

We are ſollicited to take Food, as well from the Senſe of Pain which we call Hunger, as from that of Pleaſure, which is received by the Taſte. The firſt of theſe proceeds, doubtleſs, from the ſenſible

Folds or Wrinkles of the Stomach rubbing againſt each other, by the periſtaltic Motion, joined with a Preſſure from the Diaphragm and abdominal Muſcles, by which the naked Villi of the Nerves on one Side grate againſt thoſe of the other, after a Manner intolerable. Thus we are effectually admoniſhed of the Dangers enſuing, from too long Abſtinence or Faſting, and excited to procure Food or Nouriſhment by Labour and Induſtry. To this Senſe, alſo, the gaſtric Liquor, or Juice of the Stomach, collected and ſharpened after Feeding, does, in ſome meaſure, conduce.

Thirſt is ſeated in the Tongue, Fauces, Oeſophagus, and Stomach. For, whenever theſe very ſenſible Parts, which are conſtantly and naturally moiſtened, by mucous and ſalival Juices, grow dry, from a Deficiency of thoſe or the like Humours, or are irritated by a Redundancy of muriatic or alcaleſcent Salts, here lodged, there ariſes a Senſe much more intolerable than the former, as Thirſt is more dangerous; whoſe uneaſy Senſe continues till the Proportion of diluting Water in the Blood, being recruited, reſtores the neceſſary Moiſture, and free Secretion required in the Parts before mentioned.

From hence we learn, why Thirſt attends Labour, which exhales a greater Proportion of the watery Perſpiration; and why it is a Symptom of Fevers: Where there is a Drineſs and Obſtruction of the exhaling Veſſels belonging to the Tongue and Fauces; why ſimple Water, having no Tenacity, will often not ſtick long enough to the Juices to abate Thirſt, which yields, nevertheleſs, eaſily to ſome acid Liquors, which not only moiſten and render fluid, but alſo neutralize and provoke forward the Humours.

From theſe Cauſes, Mortals, being under a Neceſſity of ſeeking Food, for the Support of Life, have,

have, from the Beginning of Ages, determined their Choice, to the ſucculent Parts of Vegetables and Animals, in ſuch a Manner, that Water and Salt ſeem to be added only as third Aſſiſtants. And firſt, it is probable, that the primitive Choice of our Foods was made by Experiments, according as the Variety of Smells and Flavours in Vegetables, and their ſeveral Parts, invited, and as the Strength and Recruit of our Faculties, thence following, confirmed their Utility. But, by degrees, Animals increaſing ſo much as to be incommodious to Man, now declining in his Conſtitution or Longevity, the Fleſh of Animals was afterwards added, as a better Support for thoſe Labours, which could not be ſo well ſuſtained by vegetable Food alone.

At preſent, both the Number and Variety of Subſtances are almoſt infinite, which we take either as Food, or Seaſoning, for our Nouriſhment.

Although there are many Inſtances of particular Perſons, and even of whole Nations, who have ſupported Life only with one kind of Food, either vegetable or animal, or even from a ſmall Claſs of either of them; and although ſome have lived altogether upon Milk, or its Whey; yet it ſeems to be neceſſary, both from the Nature and Fabric of the human Body itſelf, as well as from the known Effects which follow from only one Kind of Food, that we ought to ſupport Life, by the two Kinds of Foods, both animal and vegetable, ſo intermixed, that neither of them may exceed their reaſonable Bounds; and this Mediocrity we are taught from the Loathing itſelf, which follows to any one Kind of Food, that has been continued for too long a Time together.

The Fleſh of Animals appears a neceſſary Part of our Nouriſhment, even from the Fabric of the human Stomach itſelf, reſembling that of carni-

vorous Animals; and from the two Rows of Teeth, with the canine Teeth in each Jaw; alſo from the Smalneſs and Shortneſs of the Inteſtinum Cæcum, and from the neceſſary Vigour which we require, which is more remarkable in carnivorous Animals.

For it appears, that the Fleſh of Animals only contains the gelatinous Lymph, ready prepared for the Recruit both of our Fluids and Solids; which, being extracted from the broken Veſſels and Fibres, is readily converted into abundance of Blood.

An Abſtinence from animal Food, in thoſe who have been accuſtomed to it, generally cauſes great Weakneſs, both to the Body and Stomach; being perpetually attended with a troubleſome Diarrhæa, or Purging. (But in the Amplitude and Length of the Inteſtina Craſſa, Man agrees with herbivorous Animals.)

Eſculent Vegetables are generally of the aceſcent Kind, only ſome few of them are either alcaleſcent, or elſe repleniſhed with a Spicineſs; but none of them have that animal Glue which is ſpontaneouſly changeable into Blood: For it is only the ſmall Portion of Jelly, which is drawn from their farinaceous Parts, which, after many repeated Circulations, is converted into the Nature of our indigenous Juices. Yet theſe are neceſſary to avoid Over-repletion with Blood, and of too putreſcent a Kind, from the Uſe of animal Food alone, which, from the moſt creditable Accounts of the Anthropophagi, prevails to ſo great a Degree, as to breed the hot alcaleſcent Scurvy, a fierce or ſavage Temper, a Stinking and Leproſy of the Body, with a lixivial Corruption of all the Juices; which are only to be avoided or cured by a Change of Diet, in which a vegetable Acidity abounds. Hence it is, that we are furniſhed but with few canine Teeth; and our Appetite, in Health,

Health, but more especially in Disease, is stronger for acidulous Vegetables, in Proportion to our warmer Temperature of Body, and greater Heat of the Country, or the Season of the Year.

Hence we see, that, in the hottest Climates, People live either altogether upon Vegetables, or use Flesh Meats but very rarely, and not without Danger of acute Diseases; while, in the colder Countries, Flesh is eat freely with less Danger: And hence Bread, or something like it, is made a standing Part of our Food, throughout the World.

The best Drink is afforded by pure Water not incorporated with Salts, nor with Air; by which it may readily enter into a Fermentation. Of this Kind, we justly prefer that from a mountainous Spring, which runs clear and cold through a sandy Bed, being very light and insipid. Whenever we are unprovided with such pure and healthy Water, as is frequently the Case in low flat Countries, or when any Increase of the Strength and muscular Constriction of the Stomach is required, from a spicy Stimulus, its Place may be very well supplied by Wine, prepared chiefly from Grapes; but, in defect of those, from Apples and Pears; which, after a due Fermentation, becomes clear, and is repleniſhed with an acid Salt, and oily or inflameable Spirit, but more flatulent, heavy, and less palatable, are prepared from the several Kinds of Corn, opened by Maceration and slight Roasting, and afterwards extracted with boiling Water, and prepared by Fermentation, as a Substitute for Wine, to those Countries where the Grape does not ripen.

But Mankind have invented various Pickles and Sauces; such as Salt, Vinegar, and Acids of various Kinds, to correct the putrescent Disposition of Flesh Meats; with Pepper, Mustard, and other hot Spices, to strengthen the Action of the Stomach, which is perpetually weakened by flatulent

Vegetables: And to theſe add, the Sugar, Salt, and eaſtern Spices, which are generally added, either for the Sake of Flavour, or preſerving our Food. But all theſe yield no Nouriſhment; being deſtitute of all gelatinous Lymph, or any farinaceous Quality.

The Aliments are generally dreſſed, or variouſly prepared, according to their different Natures, the Country, Seaſon, &c. by which their Crudity is removed, their ſolid Fibres ſoftened or opened, their too much incorporated Air expelled, or their diſagreeable Acrimony reduced or changed to a Flavour that is agreeable: But, even after this, many vegetable Foods, and more eſpecially Fleſh-Meats, require to be divided, in ſome Degree, by a previous Triture in the Mouth, which is more eſpecially neceſſary in Man, whoſe Stomach is very thin, or but little fleſhy; and likewiſe, that the Food may not ſtay ſo long upon the Stomach as to become putrid. HALLER's Prim. Lin. Phyſiol.

N. B. Several Authors of Credit relate Caſes of Perſons who have lived ſeveral Years upon Barley-Water, Whey, or even ſimple Water, only. Perhaps an Account of ſome of theſe Caſes may not be diſagreeable to the Reader; not that I would adviſe any Perſon to try the Experiment.

CASE I.

In the Month of July, about eighteen Years paſt, one JOHN FERGUSON*, Herdman of the Pariſh of Kilmelford in Argyleſhire in Scotland, of the Age of Thirty-eight Years, on a warm Day

* Who now lives, and, for the Space of eighteen Years laſt paſt, hath ſubſiſted only on Water, Whey, or Barley-Water: Atteſted to the ROYAL SOCIETY, on Thurſday the 9th Day of December, 1742, by Mr. CHARLES CAMPBELL, Preacher of the Goſpel in Scotland; who, living near the ſaid FERGUSON, had been in Company, and diſcourſed with him.

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over-heating himself in Chace of Cattle, drank plentifully of cold River Water, whereupon he fell asleep by the River Side, and slept for Twenty-four Hours. On waking, he found himself in a violent Fever, was carried Home, and there desiring Drink, they gave him Water, on drinking whereof he vomited; ever since which Time he hath not been able to contain in his Stomach any Thing except Water, Whey, or Barley-Water. In the Summer Season he useth for his Food only cold Water, and in Winter only warm Whey, or Barley-Water. If, in drinking the Barley-Water, one Grain of the Barley should accidentally be swallowed, his Stomach immediately ejects the same by Vomit. In order to discover whether any Fallacy might be used, the said FERGUSON hath been, by his Father's Master, confined in a Room for twenty Days, during which Time he lived only on Water, Whey, or Barley-Water; and, during that Time, had no Stool. He hath a florid fresh Countenance, seems as other Men in other Respects, but is weak, and not so fit for Labour. His Evacuation by Urine seemeth in Proportion to the Quantity he drinks; and he generally, in his Business, walketh about five Miles every Day.

CASE II.

We likewise read*, That, in the Year 1595, a Girl, of about Fourteen Years of Age, who was brought to Cologn, had lived three Years without eating or drinking. This was verified by the Parents of the Girl, and other creditable Testimonies. FABRICIUS strictly examined her: She had a dull melancholy Countenance, her Body moderately fleshy, except her Belly, which was depressed

* Cent. ii. Obsery. 40.

and retracted to the Spine of her Back: The Liver and the reſt of the Viſcera to him ſeemed ſchirrous; ſhe never went to Stool: She loathed all Food to ſuch a Degree, that if any one ſuddenly put a Bit of Sugar in her Mouth, ſhe immediately fainted: She danced and played with other Children, and ſeemed as if ſhe ailed nothing; and her Body had its natural Colour. Her Parents told him, that about ſeven Years before that Time ſhe had recovered from a dangerous Illneſs; and that, by little and little, ſhe began to loath all Food; ſo that, in the Space of four Days, ſhe taſted no Victuals: After which, ſubſiſting only on a little new Milk, ſhe at laſt, in the Space of ſix or ſeven Days, intirely abſtained from eating or drinking.

CASE III.

SENNERTUS * relates, That another Girl, of the ſame Age, at Confolentum, a City on the Confines of Limoſin and Poictiers in France, who lived three Years without eating; an Account whereof was publiſhed by CITESIUS, a Phyſician. It appears, that in 1599, in the eleventh Year of her Age, ſhe was ſeized with a Fever, attended with a Vomiting: That, on the Remiſſion of the Fever, ſhe became ſpeechleſs, and remained ſo fourteen Days: When her Voice returned, ſhe was delirious, and had neither Senſe or Motion; and her Stomach became ſo weak, that ſhe loathed all Food: That, after ſix Months, ſhe began to recover the Uſe of her Limbs, her Stomach yet remaining in the ſame State: Her Abdomen fell in, ſo that from below her Ribs to the Os Pubis, ſhe was much altered from what ſhe uſed to be, and ſeemed as if all the Muſcles of the Abdomen, the

* Tom. II. Lib. III. Par. i. Sect. 2. De Longa Abſtinentia.

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Inteſtines, Viſcera, and all her internal Parts, had been taken from her: The other Parts of her Body ſeemed not thus emaciated; her Cheſt ſeemed full, her Breaſts moderately turgid, her Arms, Thighs, and Legs, ſufficiently fleſhy, her Face plump, her Lips were of a dark red Colour, her Tongue contracted, yet her Speech was free; the Hair of her Head was very long, her Hair, Nails, yea all her Body, ſeemed augmented. She had no Diſcharge either by the Anus, Bladder, Uterus, or Cutis; ſhe ſeemed, to the Touch, to be always cold and dry, and hardly, by any Motion, grew warm, tho' ſhe was buſied in her houſhold Affairs. She went to Market, ſwept the Rooms, ſpun, and did other Things of this Nature, her Senſes and Motion being in no Manner prejudiced.

CASE IV.

The ſame Author reports this Caſe *, taken from the Genoeſe Phyſicians, That, in 1601, a briſk lively Woman, of about Twenty-two Years of Age, was conveyed to Genoa, who was kept in Cuſtody, with a watchful Eye over her, and was found to live many Years only on Water.

CASE V.

We alſo read †, That a Girl, called Apollonia, born at Gatz, in the Juriſdiction of Bern, a City of the Switzers, who at firſt had an Averſion to Bread, and afterwards to all other Victuals, and was nouriſhed by Broths only; which, by degrees, ſhe likewiſe abhorring, uſed only ſome Spoonfuls of Wine, diluted with Water; which ſhe alſo at laſt refuſed, and lived ſome Months without eating or drinking. The Senate of Bern being in-

* Ibid.
† Ibid.

formed

formed hereof, ordered, that the Mother and the Girl ſhould be put into the Hoſpital of the City for the Diſcovery of any Fraud that might be uſed; whereupon, under the ſtricteſt Obſervation, ſhe was found to live without Aliment. What was further remarkable in this Perſon was, that the Flies, of which there was great Plenty in the Stove-room where ſhe lay, ſettling on her Face, and other naked Parts of her Body, were not at all perceived by her; neither was ſhe much affected by cold Winter Weather. She was in Switzerland in the Year 1600, and remained in this State till the Year 1612; when, about Chriſtmas-Day, her Appetite began a little to return, and, by degrees, her Stomach, Liver, and other Parts, returned to their natural State; her Abdomen, which before was extenuated and hardened, again became ſoftened and elevated, her Excretions were again had as before, her muſcular Strength returned; and ſhe, who had lived above ten Years in a weak Condition, without eating or drinking, became capable of going about and doing her Buſineſs: Yet her Senſes, which, during the Time of her Abſtinence, remained intire, began to grow languid, and her Head ſo affected, that ſhe became, in a Manner, fooliſh.

CASE VI.

I ſhall mention only one Caſe more, of this Nature, from the ſame Author*, concerning a young Woman, born at Halberſtad, in Germany, who lived above nine Years without eating.

In the Year 1614, ſhe was taken ill, and continued ſo for fourteen Days. During the Time of her Illneſs ſhe eat nothing: When ſhe recovered,

* Ibid. p. 385.

ſhe

she had such an Aversion to Victuals, that, in the Space of a Day, she hardly eat any Thing: Afterwards, being invited to a Wedding, she, by Intreaty, eating more than usual, became so ill for eight Days, that her Life was despaired of: From this Time to her Death, she eat nothing, but every Day drank about a Pint and a Half of Ale, in which, if they put, unknown to her, any Bread, she would not drink. Her Body was of a good Colour, and not emaciated. She was weak, and therefore obliged to live a sedentary Life. She died in 1623, in a dejected melancholy State, caused by the coming of some insolent Soldiers which her Mother was obliged to take in.

LECTURE VI.

Of the Nature of the CHYLE, or NUTRITIOUS SUBSTANCE.

ALIMENTS of every Kind, whether ſolid or fluid, are not only in the Stomach, but alſo in the Duodenum, which is a kind of ſuccedaneous Stomach, and in the Whole of the ſmall Inteſtines, by the Warmth of the Parts, and the Aſſiſtance of the gaſtric Lymph and the Bile, diſſolved and converted into an alimentary Liquor called Chyle; which, being ſecreted through the Inteſtines, from the recrementitious Maſs of Aliments, to be diſcharged by way of Excrements, is, by a peculiar Mechaniſm, conveyed to the Maſs of Blood.

That the Duodenum is a ſuccedaneous Stomach, is obvious, from this, that it is ſufficiently large, and has a Flexure like that of the Stomach; by means of which, the Maſs of Aliments may be the longer retained in it. It is alſo furniſhed with Menſtruums, or ſolvent Liquors, peculiar to itſelf; ſince not only a large Number of ſmall Glands, detected by BRUNERUS, which diſcharge a menſtruous Lymph, are ſituated in it; but alſo, becauſe the pancreatic Juice, mixing with the Bile, accompliſhes the farther Elaboration and Rectification of the Chyle.

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The Chyle itself is a milky insipid Liquor, consisting of oleous and mucilaginous Parts, and extracted from the dissolved Aliments.

It is, as it were, a natural Emulsion: And as, in order to constitute this, a Mixture of oleous and aqueous Parts is requisite; so, that the Chyle consists of the same Ingredients, is obvious, from those Particles, in Milk, which is nothing but Chyle, being converted into Butter, Cheese, and Serum. And as every artificial Emulsion, prepared with Water and oleous Seeds bruised, is of a whitish Colour, which arises from the Oil, reduced to small Globules, reflecting the Rays of Light; so, also, the Whiteness of the Chyle can hardly be ascribed to any other Cause than this.

BOERHAAVE has set the Analogy between Emulsions of Vegetables and Chyle in a very clear Light. He speaks only of Vegetable Substances; but if we reflect, that animal Substances, taken by way of Aliment, are originally formed from Vegetables, and, like them, consist of Oil, Earth, Water, and Salts (the last volatile); we shall readily conceive how the Organs of Digestion convert also animal Substances into Chyle, or a sort of Emulsion.

The Passage hinted at, in BOERHAAVE, runs thus: 1. If the oleaginous vegetable Substances are reduced to a Powder, or bruised, and ground in a marble Mortar with a wooden Pestle, and a little Water be slowly and successively poured upon them in the grinding, that they may then come into a well-wrought Paste, they will change into a white Mass; which the longer it is so ground, the more uniform it becomes, and the better fitted for this Process. 2. Then gradually add more fair Water, so as to make the Whole fluid, and continue the Triture without Intermission, as before; whereby the Liquor, floating above the Matter,

will

will begin to grow milky and unctuous: Let the Liquor now rest a little, then pour it off, by a gentle Inclination of the Mortar, upon a thin linen Strainer, that the finer Part may pass through into a clear Vessel. 3. To the gross Part remaining behind in the Mortar, and in the Strainer, again add fresh Water, and grind and strain as before, adding this second Liquor to the former, and repeating this for several Times, till the Liquor poured off gradually becomes less white, thick, and unctuous, and, at length, perfectly aqueous, at which Time but a very little of the Substance will remain in the Mortar, and that chaffy, poor, exhausted, and insoluble in Water, though assisted by long Triture, appearing almost merely terrestrial, without Salt, or the least Signs of Oil: Whence, by this means, the Parts of Vegetables, filled with Oil, are divided into two distinct Kinds; one dissolvable by Water, the other not.

The Liquor, thus prepared, resembles, in many Respects, the Chyle of Animals, which is itself prepared from Vegetables in their Bodies, by chewing, ruminating, and the Action of the Stomach, before it is mixed with the Bile in the Duodenum. The Thing appears evident, from the white Colour, mild Odour, sweet Taste, thick Unctuousness, and great Disposition they both have to turn sour. So, likewise, if the Liquor, thus prepared, stands some Time in a tall cylindrical Vessel, it spontaneously separates into a white, thick, and almost totally oily Part, which floats at Top, and into a thinner, transparent, bluish Colour, which remains below, wherein it perfectly resembles Milk, as dividing itself into Cream and thin Milk.

Again; if this Liquor be kept, for some Time, in a warm Air, it turns sour, and afterwards considerably sharp, though without acquiring the proper Rancidness of an expressed Oil, in which Respect,

ſpect, alſo, it perfectly agrees with Milk, which acquires the like Acidity in ſuch an Air, without becoming rancid like pure Oil. Whence this farther Remark ſhould be made; that, in acute Diſtempers, Emulſions may be given with greater Safety than expreſſed Oils. But I could never, by any Art of Coagulation I have uſed, obtain ſuch a Curd, from this Liquor, as Milk affords; whence there is this Difference betwixt the Milk of Vegetables and Animals. The Reaſon of the Difference between expreſſed Oils and Emulſions ſeems principally this; that the mealy Part, in the Grinding, being conſtantly in fine Particles, interpoſed betwixt the pure Oil, the Parts of this Oil are ſo broken, and ſeparated from one another, that, its Tenacity being changed, it becomes miſcible with Water, and thence appears in the Form of Milk, which alſo conſiſts of a fat Subſtance diſſolved in Water; whereas, when a pure Oil, it is obtained by Expreſſion; the Parts thereof, being in Contact with each other, do not admit of Water, nor ſuffer it to be mixed among them. Again, the large Quantity of Meal, intermixed with the Oil in the Emulſion, cauſes it to turn ſour, not rancid; and hence appears the Reaſon why the Liquor is white: For Whiteneſs always enſues, as often as Oil is intimately divided, and mixed with Water.

If Oil be poured upon a Glaſs of Water, the two Liquors will remain tranſparent, and ſeparate; but, if ſhook briſkly together, they will unite, in ſome meaſure; and, during that Union, the Mixture will appear perfectly white; but, if ſuffered to reſt, the Oil is collected at the Top, the Water ſinks to the Bottom, and the Whiteneſs immediately vaniſhes: And the ſame Thing frequently happens in animal Milk, diſtilled oleaginous Waters, and theſe Emulſions.

It is alſo certain, that the Whiteneſs becomes greater, the larger the Quantity of Oil; and, in this Caſe, the Liquor ſooner grows rancid; but the leſs the Oil, the leſs white the Liquor, and the ſooner it turns ſour. In the Summer, Emulſions will ſcarce keep ten Hours; but in Winter longer. To conclude, this Method of making Emulſions gives Light to the Action of Maſtication: For all the Foods prepared from Corn, abounding with a latent Oil, and being ground by the Teeth in Chewing, and mixed with the Saliva; the longer they are thus acted upon in the Mouth, the nearer they approach to theſe Emulſions, and at length always turn white, when the Saliva, Salt, and Oil, are well ground together. The Operation, thus begun in the Mouth, is carried on, in the Stomach, and more perfected in the Inteſtines, where the Matter ſtill retains the ſame Nature, except that new Juices are perpetually mixing themſelves therewith, and communicating their Properties; whereas, in our pharmaceutical Operations, there is no Addition but of Water alone. And hence we may underſtand the artificial Diſtinction between the firſt Chyle, and the Milk of Animals.

Hence we alſo learn the Origin of Fat in Animals which feed upon Vegetables; ſince Vegetables conſtantly abound with Oil, which may be prepared and extracted from them by chewing, ruminating, and the Power which the Body has of making the Chyle. 2. We hence ſee the Nature and Uſe of this Oil in Plants. 3. So we likewiſe learn the Manner whereby a Liquor, extremely like Chyle and Milk, may be produced from Oil and Water, mixed and ground together in a certain Manner; and hence perceive how the human Body acts in producing Chyle and Milk. 4. Hereby we are gradually led to conſider thoſe Oils called eſſential. 5. Phyſicians, acquainted with theſe Par-

Particulars, will not wonder whence Men in Health, who uſe little Exerciſe, ſhould abound in Fat, even though they often uſe nothing but vegetable Food; ſince Expreſſion and Emulſion can ſo eaſily extract a large Quantity of Oil from Vegetables not apparently oily. 6. Hence we ſee the Origin both of Chyle and Milk: And, 7. The Nature of thoſe Principles which conſtitute them both; which are the animal Juices, conſiſting of Saliva, the Mucus of the Mouth, Oeſophagus, Stomach, and Inteſtines; and, again, of thoſe aqueous, ſaponaceous, oily, and ſpirituous Matters, in the Liquors enumerated, which may be brought into the Form of an Emulſion, and expreſſed from the groſſer Parts by means of Maſtication, Deglutition, the Action of the Stomach, and the periſtaltic Motion. 8. Hence alſo may be eaſily deduced the phyſical Reaſon why the Milk of Animals, prepared intirely from vegetable and tartiſh Food, is ſo ſubject to turn ſour, when out of the Body. Recent verdant Graſs, by being long maſticated, or ruminated, with a large Proportion of Saliva, begins, even in the Mouth, to aſſume the Form of Milk, and promote the Production of Fat; whence Men uſually grow fat with Bread and Water, and Cattle with Water and Graſs.

Since the principal Aliment of the Chyle is an Oil, blended with a mild, gelatinous, and mucilaginous Subſtance; it is obvious, that thoſe Subſtances afford the moſt copious and laudable Chyle, which are endowed with a mild, oleous, and mucous Juice, ſuch as the Fleſh of Animals; and, in the vegetable Kingdom, all the farinaceous Seeds.

Hence the Reaſon is evident, why a Man may live upon Water and Bread alone: For theſe Subſtances include, in a due Degree and Proportion, all the Ingredients of the Chyle and Blood.

From this it also appears why, in the Eastern Countries, Rice serves the Inhabitants instead of Bread, Wheat, Oats, Peas, Beans, and Chesnuts; not only Man, but every other Species of Animals, become fat: Hence also the Reason is obvious, why those Aliments, which are not of a temperate Quality, such as acid, spirituous and saline Substances, the Juices of many Vegetables, Herbs, Roots, with acrid and aromatic Substances, are improper for producing Chyle and Nutrition.

The Chyle, extracted from dissolved Aliments, is strained through the villous Membrane of the small Intestines, conveyed to the small Orifices of the lacteal Vessels, and poured into them.

This villous Tunic, which is most conspicuous in the Jejunum, is no more than a Congeries of a large Number of villous Substances, or small Tubes variously interwoven with each other; and this Congeries is the Source and Origin of the lacteal Vessels.

That the Villi of the Intestines are furnished with Cavities observable by Microscopes, is excellently demonstrated by Brunerus, in his Treatise De Glandulis Intestinorum. From the same Author we learn, that where there are intestinal Villi, there are also lacteal Vessels; and that where the former of these are not to be seen (as in the Stomach, for instance), there the lacteal Vessels are invisible.

The villous Membrane of the Intestines is not merely passive, but, in consequence of the Afflux of the nervous Fluid and Blood, is provided with a certain Degree of Strength and Tone, or a Motion by which it is contracted and dilated; so that these small villous Canals, and the Orifices of the lacteal Vessels, may be either too much contracted, or relaxed.

In

In Spasms and Gripes of the Intestines, as also upon the Use of acrid Purgatives, or corrosive Poisons, this villous Membrane is highly constricted; so that nothing, except a fine thin Fluid, can pass through it, as is sufficiently evinced by the Symptoms common to hypochondriac Patients, and by the Flatulencies and Congestions of peccant Humours usual in such a Case.

The villous Membrane, with which the small Intestines especially are furnished, is that common Strainer through which all the Liquor is conveyed from the Primæ Viæ to the Blood, and all the other Parts of the Body: Hence it is of the utmost Importance, that this villous Membrane should be in its due and natural State; for if the Apertures of the Vessels are too wide and pervious, the gross, feculent, and recrementitious Parts of the Chyle, are conveyed to the Blood. If, on the contrary, they are too much contracted, the thin and watery Part of the Chyle is only conveyed to the Blood; whereas the more useful and alimentary Portions of it are kept back.

What Alteration the Chyle undergoes within the cellular Texture of the mesenteric Glands, is not yet sufficiently known: But it appears, in general, that some thin Liquor distils from the Arteries in this Part serving to dilute the Chyle into which it is poured. For it is observed, that, after the Chyle has passed all the Glands, it appears more aqueous; and thin Liquors, injected through the Arteries, flow out into the cellular Texture of the Glands, and are diffused into the Lymphatics.

From the last Glandules which are collected together in the Center of the Mesentery, a few, but very large, lacteal Vessels arise, which ascend from all the inferior Parts of the Body, creep over the renal Vein, and then go, with this and the Hepatics, behind the Aorta, to the lumbar Glandules;

dules: Hence the Lymphatics assume a variable Course, but most frequently terminate in a Vesicle of considerable Breadth, at the Side of the Aorta, between that and the right Appendix of the Diaphragm; there it usually appears somewhat turgid, two or more Inches long, and often ascends above the Diaphragm into the Thorax, conical both above and below. It is named Receptaculum Chyli, in which the gelatinous Lymph of the inferior Extremities, and of the abdominal Viscera, mixes with the Chyle, and dilutes its Whiteness*.

Since all the Chyle, and every other Fluid, must pass, into the Mass of Blood, through the minute capillary Vessels of this villous Membrane, and through the lacteal Vessels; hence these Ducts, and other Orifices, ought to be open and pervious, without Obstruction by any mucous Substance.

To obstruct these small Ducts of the villous Membrane, those Aliments greatly contribute, which are converted into a viscid Coagulum; such as hot Bread, farinaceous Substances, Cakes not sufficiently fermented, coagulated Milk, viscid and compact Aliments, Fat which easily runs into a Coagulum, such as that of Sheep, together with all Aliments and Medicines possessed of an astringent Quality.

Bountiful Nature has therefore wisely appointed that the Bile, in consequence of its saponaceous and abstergent Quality; and the Lymph, in consequence of its being incessantly discharged from the Glands and glandular Tunics, should preserve this villous Membrane from being obstructed by any thick and viscid Mucus.

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* But there are some Instances, where there are only two or three small, and somewhat angular Ducts, instead of this Receptaculum Chyli, or Cistern of the Chyle or lymphatic Vessels, which may be owing to the considerable alternate Pressure of the Diaphragm and Aorta; by which means, the Chyle is moved faster or slower.

Hence

Hence the Reason is evident, why the drinking of good Waters, warm Infusions of Tea and Coffee, together with Decoctions of Herbs, is so highly beneficial; since the principal Advantage, attending the Use of these Liquors, consists in this, that they keep this Membrane free from Obstructions, and preserve its Ducts open and pervious. Hence, also, it is obvious, why these Liquors, or any wholsome Waters, drank copiously, when, in consequence of the obstructed Vessels, they cannot find a free and easy Passage, excite Commotions, Flatulencies, Uneasiness, and sometimes Vomitings. Warm Fluids, how ever drank in too large Quantities, and too frequently repeated, will relax the villous Membrane, and prove highly prejudicial.

Through the villous Membrane of the Intestines there is, first of all, secreted from the Aliments, a very fine Fluid, which easily enters and passes through the several Ducts.

Hence after Meals, or drinking liberally, even of good Water, the Urine is first discharged, purely aqueous and insipid, but afterwards assumes a deeper Colour.

The Chyle does not immediately incorporate with the Blood, so as to change its Nature, as we observe from the Milk which is afterwards made of it; but about five or more Hours after a Meal, during which Space a Woman will afford Milk, after it has circulated eighty Thousand Times through the Body, fermented with Heat, and mixed with a Variety of animal Juices; it is, at length, so changed, that some of its Particles are deposited in the cellular Substance, under the Name of Fat; another Portion is configured into red Globules; and, again, another Portion into a mucous or gelatinous Substance, and into Serum: The aqueous Particles

go off, in ſome meaſure, by Urine; and ſome exhale by Perſpiration. Hence we ſee that the different Particles of the Chyle are diſtributed according to the Laws of the Animal Oeconomy.

The more groſs and coarſe Parts of the Aliment, which are not adapted to the Apertures of the lacteal Veſſels, are not conveyed to the Blood; but, being retained in the Inteſtines in conſequence of the Narrowneſs of the Lacteals, are diſcharged by way of Excrement.

If, in conſequence of the coſtive State of the Body, the more groſs Parts of the Aliment remain, for a conſiderable Time, in the Inteſtines; the more groſs, ſaline, and terreſtrial Parts, alſo, by the ſtrong Compreſſion of the Inteſtines, penetrate into the Blood.

But a Liquor is not only ſecreted in the ſmall, but alſo in the large Inteſtines, and conveyed into the Maſs of Blood through the abſorbent Veſſels.

When any one is preternaturally coſtive, the Fæces, which were before diſcharged liquid, and of a fœtid Smell, are now deſtitute of Moiſture, and free from that ungrateful Scent; which is a ſatisfactory Proof that this fœtid Liquor has been abſorbed from them.

From what has been ſaid, we may eaſily aſſign a Reaſon why a coſtive State ſhould produce a Cacochymy, and render the Humours highly impure. That there is alſo a Secretion made in the large Inteſtines, is ſufficiently obvious, from what we call nutritive Clyſters, prepared of Peruvian Bark; as alſo from antiſpaſmodic and corroborating Clyſters, prepared of nervous and cephalic Herbs, and calculated for Diſorders of the Head.

The Stomach and Inteſtines have a particular Motion, by which they are contracted and dilated: Their Motion proceeds gradually from the ſuperior

rior to the inferior Parts, and is by the Greeks called the periſtaltic Motion.

The principal Inſtruments by which this Motion is performed, are the annular Fibres, with which the whole Inteſtines are ſurrounded, and wrapped up, in a ſpiral Form; ſo that theſe Fibres are continued, in an uninterrupted Courſe, from the Oeſophagus to the Anus.

This Aſſertion may be confirmed by the following Experiment: Boil the Inteſtines of any Animal, and, after ſeparating the longitudinal Fibres, together with the exterior Membrane, the annular Fibres, in one continued and uninterrupted Series, may be ſeparated from the Inteſtine, like a long Thread.

Theſe annular Fibres, with the Aſſiſtance of the longitudinal, are the principal Inſtruments, by means of which the Contraction of the Inteſtines is produced.

The periſtaltic Motion of the Inteſtines, when in its natural State, is very eaſy and gentle.

This eaſy and gentle Motion may be juſtly looked upon as the wiſe and bountiful Appointment of Nature; leſt the Aliments, when concocted, ſhould be with too much Precipitation hurried into the Inteſtines, and too ſpeedily diſcharged; which happens in a Diarrhæa. Beſides, in conſequence of the gentle Contraction and Dilatation of the Inteſtines, only the finer and more ſubtil Portion of the Chyle is ſeparated from the Maſs of digeſted Aliments, and poured into the villous Ducts of the Inteſtines, and the Apertures of the lacteal Veſſels; whilſt, at the ſame Time, the more groſs and feculent Parts are left, juſt as happens in all Percolations; where the Strainer, upon a gentle Compreſſion, only tranſmits the finer Parts; whereas, by a ſtronger and more forcible Compreſſion, its thick and turbid Parts are, at the ſame

Time, paſſed through it. But this inteſtinal Motion is not perceptible, except in the largeſt Animals, ſuch as Oxen and Horſes, when diſſected alive.

As every Impulſe and progreſſive Motion of Humours require a Cauſe or Principle ſufficiently qualified for producing a due Degree of Motion; ſo, with reſpect to the periſtaltic Motion of the Stomach and Inteſtines, we find a threefold Cauſe; the firſt of which is lodged in the Pharynx, the ſecond in the Pylorus, and the third in the Beginning of the Inteſtinum Colon.

By a ſtrong Contraction of the Pharynx and the Tongue, the Aliments are thruſt into the Cavity of the Stomach, through the Oeſophagus; then, by the right and inferior Parts of the Stomach, by means of the Action of the Pylorus, the Contents of the Stomach are propelled through the ſmall Inteſtines, till they arrive at ſuch as are larger, and more capacious; where, about the right Ileum, is the Beginning of the Colon, which conſiſts of very ſtrong, nervous, muſcular, and fibrous Membranes, and by whoſe Motion and Impulſe the Excrements are forced to the Anus.

The Motion of the Inteſtines, by means of which their Contents are propelled or carried forwards, is ſufficiently ſtrong, ſince it overcomes a conſiderable Reſiſtance, and forces Quickſilver, almoſt the heavieſt of all Minerals, up and down, through all their various Convolutions and Windings, till it is diſcharged by the Anus; which we obſerve in thoſe afflicted with the Iliac Paſſion, who often receive conſiderable Relief by taking large Quantities of this metalline Fluid*.

* Provided the Introſuſception ariſes from the inferior Portion of the Inteſtine; otherwiſe this Fluid will increaſe the Diſorder to a fatal Cataſtrophe: As I found in ſome Subjects who died of this Diſeaſe.

This

This Motion, whereby the Intestines are contracted and dilated, is successive and reciprocal. For while one Part of the Intestine is contracted, and rendered narrower; the Substance contained in it is pushed forward to the adjacent Part; which, by that means, is dilated; and, upon the Cessation of that Dilatation, is forthwith contracted again.

As, in order to preserve the continual Circulation and progressive Motion of the Blood and Humours, such is the Construction of the moving Fibres, in the Heart and Arteries, that their Dilatation or Diastole becomes the Cause of their Systole, which again produces their Diastole: So also the like Condition of moving Membranes and Fibres is observed in the Structure of the Intestines; so that their Dilatation produces their Contraction, and, vice versa, their Contraction proves the Cause of their Dilatation.

If then the Contraction of the Intestines is the Cause of their Dilatation; and if, on the contrary, their Dilatation gives Birth to their Contraction; it follows, that, by producing either a stronger Dilatation or Contraction only in one Part of the Stomach and Intestines; the peristaltic Motion, in general, must by that means be accelerated, and the Fæces, of course, more speedily evacuated.

Hence the Reason may easily be understood, why, by a purgative Medicine, which is frequently lodged in one Part of the Intestine, and excites a painful Constriction, the Contents of the Intestines are as speedily and forcibly discharged, as we observe them to be in acrid Humours and bilious Diarrhæas. Hence the Reason is also obvious, why, by drinking copiously of any Liquor which is impregnated with a stimulating, and especially a saline Principle, the Contents of the Intestines are soon expelled, as we observe in drinking hot and acidulated Waters.

As

As the Strength, Tone, and contractile Force, of all the moving Parts of the human Body, depend upon a free and uninterrupted Influx of the fine nervous Fluid, and the purer Part of the Blood; so the peristaltic Motion of the Stomach and Intestines depends upon the same Cause.

All those Medicines which increase the Strength, and augment and restore the Vigour and Tone of the Parts; such as Substances impregnated with a highly subtil, fragrant, oleous and aromatic Oil; or such as contain a volatile subtil Salt, or such as abound with a mild and balsamic Resin; are excellent Preservatives of the Motion of the Intestines, and restore it when become too languid: Whereas, on the contrary, Substances which impair the Strength, such as fœtid Medicines, Opiates, too powerful Refrigerents, Acids, and Astringents, greatly impair the Vigour of these Parts. But that the nervous Fluid is subservient to the Motion of the Intestines, is, I think, obvious; because the Passions of the Mind, which principally act upon this Fluid, may also alter, increase or destroy, the natural Motion of the Stomach and Intestines.

The peristaltic Motion, therefore, of the Intestines, is the principal Cause, both of the Secretion of the Chyle, and of its Conveyance through the lacteal Vessels. Besides, the progressive Motion of the Chyle to the Mass of Blood is not a little assisted, first, by what we call the Valvulæ Conniventes, large Numbers of which are observable in the small Intestines, which, when a Compression of the Parts is made, hinder the Chyle from slipping instantaneously by the Orifices of the Lacteals and the intestinal Villi: For in these the Mass of digested Aliments ought to remain for some Time, that the Chyle may be the better expressed from it, and conveyed purer and better into the lacteal Vessels.

Vessels. Secondly, To the more easy Reception of the Chyle into the small lacteal Vessels, and the intestinal Villi, the Narrowness of their Diameters contributes not a little; which is confirmed by Experiments made with capillary glass Tubes; in which Fluids will spontaneously ascend. Thirdly, The progressive Motion of the Chyle, and its Ascent through the lacteal Vessels and thoracic Duct, is much assisted by the semilunar Valves, with which they are furnished: For these Valves consist of slender and moving fleshy Fibres, by whose Motion the Fluid is carried from one Valve to another. These Valves are so situated, that the Chyle and Lymph may be carried upwards with a progressive Motion, but cannot regurgitate, or have a retrograde Motion. Fourthly, The Progress of the Chyle is also assisted and promoted by the Impulse of the Fibres; of which those remarkable conglobate Glands, situated at the Center of the Mesentery, consist.

The Progress of the Chyle, through the thoracic Duct and lacteal Vessels, to the Blood, is considerably promoted, likewise, by Respiration; in which there is a continual and successive Contraction and Dilatation of the Muscles of the Abdomen.

Since, in Inspiration and Expiration, the strong Contraction and Dilatation of the abdominal Muscles not only force the Aliments from the Stomach and Intestines, but also promote the Expression of the Chyle; it is for this Reason prejudicial both to Digestion and to Health, after a liberal Meal to talk too loud, or to use too violent Exercise: But four or five Hours after, when the Digestion is finished, Motion and Exercise are so far from being hurtful, that they are rather beneficial; as, by increasing Respiration, the Secretion and progressive Motion of the Chyle are more effectually promoted. Fred. Hoffman, Tom. I.

LECTURE VII.

Of the LIVER.

THE Liver is the largeſt Gland of the Body, and of a pretty compact Subſtance; commonly of a dark red Colour, a little inclined to yellow, ſituated immediately under the Arch of the Diaphragm, partly in the right Hypochondrium, which it almoſt intirely fills; and partly in the Epigaſtrium, between the Appendix Enſiformis and Spina Dorſi; terminating, commonly, in the left Hypochondrium, into which it ſometimes runs a conſiderable Way.

The Figure of the Liver is irregular; it being convex on the ſuperior Surface, unequally concave on the inferior, and very thick on the right and poſterior Sides. Towards the left anterior Side, its Thickneſs decreaſes very much, and terminates there by a kind of Edge; and it is broader from right to left, than from before backwards.

The Liver may be divided into two Extremities, one major, the other minor; two Edges, one anterior, the other poſterior; two Surfaces, one ſuperior and convex, which is ſmooth, and proportioned to the Arch of the Diaphragm; the other inferior, concave, and uneven, with ſeveral Eminences and Depreſſions.

It may likewiſe be divided into two lateral Parts, called Lobes; one of which is termed the major or right Lobe, the other the minor or left Lobe.

Theſe

These two Lobes are distinguished above by a membranous Ligament; and below, very plainly, by a considerable Sciſſure, lying in the same Direction with the superior Ligament.

The Eminences on the concave Side of the Liver belong to the major Lobe. The principal Eminence is a Sort of triangular or pyramidal Apophysis, situated posteriorly near the great Sciſſure, which distinguishes the two Lobes.

This triangular Eminence is termed Lobulus Spigellii, or Lobule of the Liver: One of its Angles advances a considerable Way towards the Middle of the inferior Side of the great Lobe, and is lost there.

This Angle is like the Base of the Lobulus. Towards the anterior Side there is another Eminence, less prominent, but broader; and to this Eminence, and the former, the Antients gave the general Name of Portæ.

The Depressions on the concave or inferior Side of the Liver, which deserve our Attention, are four in Number. The first is, the Sciſſure that separates the two Lobes which run across the concave Side, from the Eminences already mentioned, to the anterior Edge, where it terminates, by a Sinus of different Depths in different Subjects: This is termed the great Sciſſure of the Liver; and, in some Subjects, Part of it is tubular.

The second Depression is situated transversly between the two Eminences of the great Lobe, and filled by the Sinus of the Vena Porta; so called, by the Antients, because it lies between the Eminences of the same Name.

The third Depression is posteriorly, between the great Lobe and Lobulus Spigellii; and the Vena Cava passes through it.

The fourth is a kind of Sulcus between the Lobulus and small Lobe of the Liver, which, in the Fœtus,

Fœtus, ſerved to receive a venal Canal; but is degenerated, in Adults, into a kind of Ligament.

This Sulcus is, in ſome meaſure, a Continuation of the great Sciſſure, and makes an acute Angle with the Vena Cava.

Beſides theſe four Depreſſions, there is one, on the anterior Surface of the great Lobe, in which the Veſicula Fellis reſides; and it ſometimes runs as far as the Edge, where it forms a ſmall Sinus. We may likewiſe reckon, among theſe Depreſſions, a ſmall ſuperficial Cavity in the poſterior and lateral Part of the inferior Side of the great Lobe, by which it reſts on the right Kidney; and likewiſe a ſuperficial Cavity in the left Lobe, where it runs over the Stomach.

Laſtly, On the poſterior Margin of the Liver there is a great Sinus, common to both Lobes, which gives Paſſage to the Spina Dorſi and Oeſophagus, near the Place where the Vena Cava deſcends: And we ſometimes meet with Sciſſures, on both Sides of the Liver, which are not common.

Ligaments of the Liver.

The convex Side of the Liver is commonly connected to the Diaphragm by three Ligaments, which are only Continuations of the membranous Laminæ of the Peritonæum. One lies near the utmoſt Extremity of each Lobe, and one in the Middle; and they are accordingly termed the right, middle, and left Ligaments.

There is a cellular Subſtance, in the Duplicature of each, in which the ſanguíneous and lymphatic Veſſels run, which ſends off a kind of Lamina into the Subſtance of the Liver.

The right Ligament ſometimes connects the great Lobe to the Cartilages of the falſe Ribs; and the left Ligament, or that of the ſmall Lobe, is often double, and advances towards the middle

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Ligament. This middle Ligament begins low, in the great Sciſſure of the Liver, near the Eminences called Portæ; and from thence paſſes thro' the anterior Sinus, and over the convex Side of the Liver at the Union of the two Lobes, and is fixed obliquely in the Diaphragm.

It is likewiſe fixed ſuperiorly and interiorly to the right Vagina of the Muſculus Rectus obliquely, in ſuch a Manner, as to be nearer the Linea Alba inferiorly.

Beſides theſe Ligaments, the great Lobe is likewiſe connected to the right Ala of the tendinous Portion of the Diaphragm, not by a Ligament, but by a broad and immediate Adheſion, without the Intervention of the Membrane of the Peritonæum, which is only folded quite round this Adheſion, to form the external Membrane of all the reſt of the Body of the Liver.

This broad or ſtrong Adheſion is commonly, though improperly, called Ligamentum Coronarium: But, in the firſt Place, it is not a Ligament, as has been already obſerved; and, ſecondly, it is not circular, but oval, and very oblong.

It is not on the ſuperior Part of the convex Side of the Liver, but along the poſterior of the great Lobe, the broad Extremity of the Adheſion, lying nearer the Sinus, and the pointed Extremity towards the right Hypochondrium.

The middle Ligament, improperly called Ligamentum Hepatis Suſpenſorium, contains in its Duplicature a thick white Rope, like a round Ligament, which was the umbilical Vein in the Fœtus. Thus the inferior Part repreſents a Falx, the convex Edge of which is ſharp, and the other rounded.

All theſe Ligaments ſerve to keep the Liver in its proper Situation, and to hinder it from inclining

clining too much towards either Side: But we must not imagine that any of them serve to suspend it; because it is sufficiently supported by the Stomach and Intestines, especially when they are filled.

When the Stomach is empty, or when we fast longer than ordinary, it is common to say, The Stomach pinches us: As the Liver is not then sustained by the Stomach and Intestines, it descends, by its own Weight, and, chiefly by means of the middle Ligament, pulls the Diaphragm along with it.

It is in that Place, therefore, that we have this uneasy Sensation; and not at the superior Orifice of the Stomach, as is commonly believed.

The right or great Lobe of the Liver, which lies in the right Hypochondrium, rests on the right Kidney by the small superficial Depression before mentioned; and it likewise covers a Portion of the Arch of the Colon and the Pylorus.

About two Thirds of the small or left Lobe lie in the Middle of the Epigastrium, and one Third advances over the Stomach, towards the left Hypochondrium.

This small Lobe is situated almost horizontally; the great Lobe is very much inclined, and its thick Extremity runs down, almost in a perpendicular Direction, to the right Kidney, on which it lies *, in the Manner already said.

Structure of the Liver.

The Liver is composed of several kinds of Vessels, the Ramifications of which are multiplied in

* This Observation is very useful to distinguish the different Parts of the Liver in Wounds and chirurgical Operations.

It may likewise serve to direct us in examining a Liver when taken out of the Body; the Situation of which may otherwise be very easily mistaken, especially that of the Parts of the concave Side and the Passage of the Vena Cava between the Substance of the great Lobe and the Lobulus Spigelii.

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an aſtoniſhing Manner, and form, by the Intertexture of their capillary Extremities, innumerable Collections of ſmall pulpy friable Corpuſcles, which are looked upon to be ſo many Organs deſigned to ſeparate, from the Maſs of Blood, the Bile.

The greateſt Part of theſe Veſſels, from one End to the other, is included in a membranous Vagina called Capſula Venæ Portæ, or Capſula Gliſſoni; from GLISSON, who firſt deſcribed it particularly.

VENA PORTA HEPATICA.

The particular Trunk of the Vena Porta Hepatica is ſituated tranſverſly between the broad anterior Eminence of the great Lobe of the Liver and the Root of the Lobulus, in a particular Sciſſure, and forms what is called the Sinus of the Vena Porta; from this Sinus five principal Branches go out, which are afterwards divided into Millions of Ramifications through the whole Subſtance of the Liver.

There the Vena Porta lays down the common Office of a Vein, and aſſumes that of an Artery as it enters and is again ramified in the Liver.

The Extremities of all theſe Ramifications of the Trunk of the Vena Porta Hepatica end in the pulpy friable Corpuſcles, which ſeem to be thick villous Folliculi, when viewed thro' a Microſcope in clear Water.

PORI BILARII, & DUCTUS HEPATICUS.

It is in theſe Folliculi that the Bile is ſecreted; and it is immediately collected in the ſame Number of Extremities of another kind of Veſſels, which unite, by numerous Ramifications, into one

common Trunk: Theſe Ramifications are termed Pori Bilarii, and the Trunk, Ductus Hepaticus; and the Ramifications of theſe two Kinds of Veſſels are inveſted together by the Capſula of the Vena Porta. See Ductus Choledochus.

Hepatic Veins.

The Blood, deprived of this bilious Fluid, is reconveyed to the Heart by a great Number of venal Ramifications, which afterwards unite into three principal Branches, beſides others, that are leſs conſiderable, which terminate in the Vena Cava; and are all called by the Name of Vena Hepatica.

The capillary Extremities of the Ramifications of the Vena Cava join thoſe of the Vena Porta, and accompany them through the Liver; and yet the great Branches of both Veins interſect each other in ſeveral Places.

When we cut the Liver in Slices, it is eaſy to diſtinguiſh, in each Slice, the Ramifications of the Vena Cava, from thoſe of the Vena Porta; the firſt being thinneſt and largeſt, and adhering cloſeſt to the Subſtance of the Liver: Whereas thoſe of the Vena Porta, which are inveſted by the cellular Capſula, appear to be a little ruffled, when empty; becauſe the cellular Capſula ſubſides, when it is cut; but the other Veins remain uniformly open, their Sides adhering to the Subſtance of the Liver.

Hepatic Artery and Veins.

The Liver receives, from the Arteria Cæliaca, a particular Branch termed Arteria Hepatica, which being very ſmall, when compared with the Volume of that Viſcus, ſeems deſigned only for its Nutrition, and not for the Secretion of the Bile, as ſome Anatomiſts have imagined. The Plexus Hepa-

ticus formed by the Nervi Sympathetici, Maximi, & Medii, furniſhes a great Number of Nerves to the Subſtance of the Liver. The Ramifications of the Artery and nervous Plexus are included in the cellular Capſula, together with thoſe of the Vena Porta, and Pori Bilarii.

The Pulſation of this Artery has been, by ſome Anatomiſts, taken for that of the Capſula, and which they have endeavoured to explain the arterial Office of the Vena Porta by: But they have not conſidered, that the Blood, in this Vein, does not require to be pumped forwards; becauſe ſo ſwift a Motion would have been prejudicial to the Secretion of the fine Oil of the Bile, for which a ſlow, and almoſt inſenſible Motion is neceſſary.

The Liver is covered exteriorly with a particular Membrane, or Tunic, which is a Continuation of the Peritonæum; there is likewiſe a membranous or filamentary Subſtance that runs through this whole Viſcus, and connects the Ramifications and Extremities of all its Veſſels to each other: This Subſtance ſeems to be a complicated Production of the Capſula of the Vena Porta, and of the external Membrane of the Liver.

The exterior Surface of this Tunic is very ſmooth, but that of the interior is uneven, being made up of a great Number of thin membranous Laminæ; between which we obſerve, very diſtinctly, numerous lymphatic Veſſels, on both the convex and concave Sides of the Liver: And it is more difficult to trace thoſe which accompany the filamentary Subſtance through that Viſcus.——

The Subſtance of the Liver is chiefly formed of an infinite Number of pulpy friable Corpuſcles, each of which is bounded, and, in a manner, ſurrounded by a particular Expanſion of the Capſula Gliſſoni; and all theſe Expanſions are connected

by the common Septa, in some measure resembling a Bee-hive.

These Corpuscles *have several Angles, especially on the interior Surface of the Liver; but near the Surface they are raised, in the Form of small Tubercles.

Their pulpy Texture appears like radiated Villi, a small void Space being left in the Middle of each.

Ductus Choledochus.

The hepatic Duct, or Trunk of the Pori Bilarii, having run a little Way, joins another Canal, called Ductus Cysticus, or Vesicularis, because it comes from the Vesicula Fellis, as shall be shewn in the Description of that Organ.

These two united Ducts form a common Trunk named Ductus Choledochus, because it conveys the Bile into the Duodenum: This Duct, having reached the Incurvation of the Duodenum, insinuates itself through the Tunics of that Intestine, and opens into the Cavity thereof, not by a round Papilla, but by an oblong Orifice, rounded superiorly, and contracted inferiorly, like a common Tooth-picker.

The Edges of this Orifice are raised, broad, and plaited; as may be seen, by making this Portion of the Duodenum swim in clear Water. At the Entry of this Orifice there is another smaller Opening distinct from it, which is the Orifice of the Ductus Pancreaticus.

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* If we blow through a Pipe into the Vena Porta, Vena Cava, Arteria Hepatica, or Trunk of the Pori Bilarii, but especially through the two Veins; we observe the Liver to swell, and the Corpuscles, near the Surface are raised, and become more sensible. If we blow with a great Force, we burst these Corpuscles; and the Air, getting between them and the external Membrane, raises it, from the Substance of the Liver, in Blisters.

Vesi-

Vesicula Fellis,

Or Gall Bladder, is a kind of ſmall Bag, ſhaped like a Pear; that is, narrow at one End, and wide at the other. The wide Extremity is termed the Fundus, or Bottom; the narrow Extremity, the Cervix or Neck; and the middle Portion, the Body.

About one Third of the Body of the Veſicula lies in a Depreſſion, on the concave Side of the Liver, from the Trunk or Sinus of the Vena Porta, where the Neck is ſituated, to the anterior Edge of the great Lobe, a little towards the right Side, where the Bottom is placed, and, in ſome Subjects, it advances beyond the Edge*.

The Gall-Bladder is compoſed of ſeveral Tunics, the exterior of which is a Continuation of that which inveſts the Liver, and, conſequently, of the Peritonæum.

The ſecond Tunic is muſcular, and conſiſts of two Strata, one longitudinal, the other tranſverſe; the Fibres of which have nearly the ſame irregular Direction with thoſe of the Stomach: And this Diſpoſition of the Fibres in the Viſcera is owing to the different Diameters in the ſeveral Portions of them, and to their Incurvation.

Theſe two Tunics are connected by a cellular Subſtance continued between the Veſicula and the Liver, all the Way to a whitiſh Stratum, which is looked upon as the third Tunic of the Gall-Bladder, anſwering to the Tunica Nervoſa of the Inteſtines.

* Therefore, when we ſtand, the Veſicula Fellis lies in a Plane inclined a little from behind forwards; when we lie on the Back, it is almoſt inverted; when on the right Side, the Bottom is turned downwards; and it is turned upwards, when we lie on the left Side: And theſe Situations vary, according to the different Degrees of each Poſture.

The interior or fourth Tunic has, on the Inside, a great Number of reticular Folds, filled with small Lacunæ, like perforated Papillæ, especially near the Cervex of the Vesicula, where these Folds are longitudinal, and afterwards form a kind of small Pylorus, with Plaits of the same Nature with those in the great one. These Lacunæ are looked upon to be Glands.

That Side of the Vesicula which lies next to the Liver, is connected to the Viscus by a vast Number of Filaments, which look themselves into the Substance of the Liver; and among these Filaments there are some Ducts * which form a Communication between the Pori Bilarii and Vesicula. They are most numerous near the Cervix of the Vesicula, and named Ductus Cyst-Hepatici, or Hepatico-Cystici.

The Cervix of the Vesicula is formed by the Contraction of the small Extremity; and this Cervix bending afterwards in a particular Manner, produces a narrow Canal named Ductus Cysticus. This Incurvation represents, in some measure, the Head of a Bird; of which the Cystic Duct, by the gradual Diminution of its Diameter, expresses the Beak. This cannot be seen when the Liver is extra Situm; and even in Situ it is but very imperfectly seen, when, in order to view the concave Side, the Liver is raised, and thrust too much against the Diaphragm: For by thus inverting the Liver, the Curvature is disordered, and we see two in the Place of one.

This Incurvation may be of Use to hinder too precipitate a Discharge of the Bile contained in the

* These Ducts have been observed in Brutes a long Time ago; and have been lately discovered in Men likewise.

† To see this Curvature in its true natural Situation, the Liver is to be raised but very little, and the Duodenum left untouched; then we must stoop, and look under the Liver, without moving any Thing.

Vesi-

Veſicula, which ſome Situations of the Body might occaſion.

The Cervix of the Veſicula is nearly of the ſame Structure with the other Parts. It has, on the Inſide, ſeveral reticular Rugæ, and ſome Folds, which appear like Fragments of Valvulæ Conniventes, ſituated very near each other, from the Cervix to the Contraction of the cyſtic Duct. The firſt of theſe Folds is pretty broad and large, and almoſt circular; the next is more oblique, and ſmaller in Size; and the reſt diminiſh in the ſame Manner. Taken all together, they form a kind of ſpiral Flight, which may be ſeen through the Cervix on the Outſide, where it ſometimes appears like a Screw, eſpecially when the Cervix is filled with any Fluid. This Obſervation is owing to HEISTER.

By ſlitting the Cervix and Duct, we ſee all theſe Folds very diſtinctly, eſpecially when we examine them in clear Water: When they are viewed in any other Manner, they often deceive us; being miſtaken for true Valves, becauſe of their tranſverſe Situation. They may, however, in ſome meaſure, ſupply the Place of Valves, by hindering the Bile from running too faſt into the Duodenum, and the Contents of the Duodenum from entering this Duct.

The internal Surface of all theſe biliary Ducts, that is, thoſe of the hepatic Cyſtic and Choledochus, which, being examined through a Microſcope in clear Water, appear to be nearly of the ſame Structure through their whole Extent.

The cyſtic and hepatic Ducts do not, in their natural Situation, repreſent the capital Y of the GREEKS, where they form the Ductus Choledochus: After the Incurvation of the Cervix of the Veſicula, theſe two Ducts run very near each

other; and they appear to be separated only by raising up the Liver to view them. The same Disorder happens in an inverted Liver, extra Situm; for then the Body of the Liver subsides, is flattened, and thereby separates the Ducts: Whereas, in its true Situation, it is very much incurvated, and the Ducts come very near each other.

The Ductus Choledochus appears rather to be a Continuation of the Ductus Cysticus than the common Trunk of that, and of the Ductus Hepaticus: For I have observed, that this last Duct runs for some Space, within the Sides of the former, before it opens into the Cavity, much in the same Manner as the Ductus Choledochus passes into the Duodenum; and likewise observed, at the Opening of the hepatic into the cystic Duct, a small loose valvular Membrane, which may hinder the Bile from returning out of the Ductus Choledochus into the Hepaticus.

The Bile which passes through the Ductus Hepaticus into the Choledochus, may be called hepatic; and that which is collected in the Vesicula Fellis may be termed cystic. The hepatic Bile flows continually through the Ductus Choledochus into the Duodenum; whereas the cystic Bile flows only by means of Plenitude, or Compression.

Remarks on the Vessels, &c. of the LIVER.

The Trunk of the Vena Porta Ventralis terminates between the Lobulus and the opposite Part of the great Lobe, and there joins the Trunk of the Vena Porta Hepatica in the transverse Sinus of the Liver, between the right Extremity and the Middle of that Sinus.

The umbilical Ligament, and consequently the umbilical Vein, in the Fœtus, joins the Trunk of the Vena Porta Hepatica towards the left Extremity

mity of the tranſverſe Sinus of the Liver. The Canalis Venoſus in Man is not exactly oppoſite to the Vena Umbilicalis, but a little on the right Side; and therefore theſe three Veſſels lie in ſuch a Direction, as to form two oppoſite Angles.

In the Fœtus, therefore, the Blood which comes from the umbilical Vein does not run directly through that contained in the Vena Porta Hepatica, in the Sinus, and from thence into the Canalis Venoſus; but is obliged to turn from Left to Right, and ſo to mix with the Blood in the Vena Porta, before it enters that Canal, which opens into the Trunk of one of the great hepatic Veins of the Vena Cava, near the Diaphragm.

The Hepatica Vena Porta gives off commonly five large Branches into the Liver; viz. three from its right Extremity into the great Lobe; two from its left Extremity into the ſmall Lobe; and, from the Interſtice between theſe, a ſmall Branch goes directly to the Middle of the convex Side of the Liver.

The hepatic Veins are commonly three large Bunches of the Trunk of the Vena Cava Inferior, which go out from it by one common Opening, eſpecially two of them; and then ſeparating, they enter the Subſtance of the Liver, interſecting the Branches of the Hepatica Vena Porta, and are ramified, in all Directions, in the Manner already explained. The inferior Portion of the Opening of theſe Veins into the Vena Cava, forms a kind of ſemilunar Valve.

Below theſe hepatic Veins, the Vena Cava Inferior ſends off, in its Paſſage by the Liver, ſeveral other ſmall hepatic Veins immediately from the Trunk, which ſeem to have the ſame Relation to the hepatic Artery, as the great Veins to the Vena Porta.

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The Paſſage of the Vena Cava is through the right Portion of the poſterior Sinus of the Liver, and conſequently on the Side of the great Lobe, which is ſufficiently hollowed at this Place to give Paſſage to the Vein, of which it ſurrounds above three Fourths, ſometimes more, and ſometimes the Whole.

This Paſſage anſwers to the Interſtice between the Lobulus and the reſt of the great Lobe; and its Direction is, in the natural State, from above downwards, and a little from right to left; but when the Liver is viewed extra Situm, and inverted, it appears very oblique, but ſtill ſerves as a Guide to Beginners, who are very apt to be miſtaken in examining an inverted Liver, as I have already obſerved.

The Trunk of the great Vena Porta, the hepatic Arteries, the Ductus Hepaticus, or Trunk of the Pori Bilarii, and the Nerves of the Plexus Hepaticus, form all together a large Bundle, before they enter the Liver: The Trunk of the hepatic Vena Porta is in the Middle of this Bundle, the hepatic Arteries lie on the right and left Sides of this Trunk, the Nerves ſurround it on all Sides, and they communicate with the Plexus Meſentericus Superior.

Afterwards the firſt Branches of the Arteries, Nerves, and Pori Bilarii, leave the Trunk of the great Vein, and join, in the ſame Manner, the Trunk of the ſmall or hepatic Vena Porta, and its Ramifications in the Capſula Gliſſoni, explained above.

All theſe Branches of the Vena Porta, and of the Arteries, Nerves, and Pori Bilarii, accompany each other, by Ramifications, through the whole Subſtance of the Liver; forming every-where ſmall Faſciculi, in the ſame Manner as the large Bundle is formed by their Trunks. Each Ramus of the

Vena

Vena Porta, Artery, Nerve, and Porus Bilarius, has a proper Vagina; and all the four have a common Vagina, diſtinguiſhed from the former by cellular Septa, which are only Continuations of the Vaginæ of both Kinds.

The convex Side of the common cellular Vagina is connected quite round, to the Subſtance of the Liver, by numerous Filaments which ariſe from it, and which form the cellular Subſtance found between the glandular Corpuſcles. The concave Side produces the cellular Septa above mentioned.

In this common Vagina the Veſſels, Ducts, and Nerves, are diſpoſed in ſuch a Manner, as that the Rami of the Vena Porta chiefly fill the Cavity of it, and is in a lateral Situation; the arterial Ramus and Porus Bilarius lie together on the Side of the Vein, and the Nerve is divided into ſeveral Filaments, which run in between the Veſſels and Ducts, and chiefly accompany the Artery and Porus Bilarius, the Vena Porta having by much the feweſt.

Diſorders the LIVER is moſt ſubject to.

The Inflammation of the Liver is ſeated in the Extremities of the Ramifications of the Vena Porta, or hepatic Artery: And it is evident, from the Diſpoſition of thoſe Veſſels, that an Inflammation, in either of them, muſt ſoon be ſucceeded by one or other.

The antecedent Cauſes of both theſe Species of Inflammation, are the ſame as the general Cauſes; but there are other local Cauſes, which relate more immediately to the particular Part: As an extraordinary Degree of Fatneſs in the Omentum may raiſe an Inflammation in the Liver, not only by compreſſing it, but alſo by the Diſſolution of the olea-

oleaginous Matter, either by Exercise, Getation, or Heat; and afterwards absorbed into the Veins, and conveyed to this Organ in too large Quantities, may occasion an Inflammation. This Disorder may also be produced by an atrabilarious Temperament of the Blood or Bile: For when such a Constitution is induced by an intimate Union of the Earth and Oil, with a Dissipation of the spirituous and aqueous Particles of the Blood or Bile; either of these Substances becomes the Subject of Concretion and Stagnation, in the minute Extremities and Branches of the hepatic Artery or Veins.

The Liver, likewise, suffers from Disorders in remote Parts of the Body: As if acrimonious Pus, Ichor, or a scorbutic Sanies, be deposited in any other Organ; these, upon the Accession of Heat, a Fever, violent Commotions, an improper Diet, ill-applied Medicines, or Poison, are colliquated, moved, and conveyed into the Blood, which are deposited in the Liver.

Besides these bad Effects, the Bile, when sanguineous, acrimonious, and exalted, or what the Antients named adust, if put in Motion by adequate Causes; a petrous, chalky Concretion, a schirrous Callus, Steatoma, Abscess, or Worms, occupying some Part of the Liver, Gall-Bladder, or biliary Ducts; upon the Accession of any Cause sufficient to put them in Motion, by the small Ramifications of the hepatic Vessels, excite therein an Inflammation.

Cold, also, applied to the Liver when, by any Means, over-heated, contracts the Vessels, and indissipates the Fluids, which produces an immediate Inflammation. Cold has much the same Effect, whether it is applied by means of the Air, Liquors drank, or Bathing. An Abstinence from diluting Liquors, during excessive Motion, great Heat,

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and profuſe Sweating, will alſo cauſe an Inflammation in the Liver, &c. for when the Blood is deprived of its aqueous Particles, without a freſh Supply, it thickens, and ſtagnates in the capillary Veſſels: Juſt as Abſtinence from Drink, in burning Fevers, will produce a like Effect.

When it is only a ſimple Inflammation, the ſmall Veſſels are obſtructed; hence a Tumor ariſes, which compreſſes the adjacent Parts, and, by that Means, propagates the Tumor to them: Thus it proceeds till almoſt the whole Organ is affected; which then compreſſes the Stomach, and is alſo compreſſed by it, when full. It likewiſe affects the Diaphragm, and ſometimes excites Pain, and inflames that Part: Beſides which, all the Blood received by the Cæliac Artery, and the meſenteric Arteries, is intercepted, and ſtopped at the Liver; and, in conſequence of this, the Circulation of the Fluids of the abdominal Viſcera are intirely obſtructed: Therefore Secretion, Excretion, and the Circulation of the Bile, is hindered. Hence various Kinds of Jaundices are produced, with all ill Conſequences; Putrefaction of the abdominal Viſcera, &c.

From what has been ſaid, concerning the Diſorders of the Liver, many Symptoms, which occur in acute Diſtempers, frequently erroneouſly attributed to Malignity, may be clearly underſtood. For the State of all the abdominal Viſcera, and their reſpective Actions, as Digeſtion, Aſſimilation, and Nutrition, recruiting the Blood with freſh Supplies, and the Expulſion of the Excrements, depend upon the Liver.

In this Organ there are three Sorts of Humours, which readily putrefy by Heat; that is, a thin Blood, in large Quantities; the cyſtic and hepatic Bile: It is farther obſervable, that the Situation of the Liver is ſuch, as renders it very ſubject to affect

fect the Diaphragm and Heart; and that when the Extremities of the biliary Ducts are obstructed, the bilious Fluid is conveyed by the Vena Porta, and then has an easy Access into the Vena Cava. Hence the Nature of the Black Vomit (a Disease very frequent in the West Indies) may be better understood.

By considering all these Circumstances, we may arrive at an accurate Knowledge of the various Species of Jaundice; why it is that this Distemper is sometimes easily cured, and under what Circumstances; why it sometimes proves fatal very suddenly, and at other Times continues long before it destroys the Patient; why it sometimes comes on, remains, disappears, and returns, at certain Periods; why the Appearance, Cessation, and Return, of a Jaundice, are so frequently preceded by Anxieties, excessive Vomitings, Pain, and Convulsions; and therefore the Bile being prevented, in the large Ducts, from flowing into the Duodenum, why a Jaundice, appearing in an acute Fever, before the seventh Day, is a bad Presage; and why, after the seventh Day, it scarcely admits of a Cure: Why a copious Dysentery, of no long Continuance, effectually cures a Jaundice; why Bleeding affords but little Relief in Inflammations of the Liver; because the biliary Organs have not so immediate a Communication with other Parts of the vascular System, but form, as it were, a separate Circulation; why it is of so great Consequence, in acute Diseases, to examine the Tumors and Elevations of the Hypochondria*; why

* Mr. PETIT gives several Instances where the Gall-Bladder was so much distended with Bile, as to be mistaken for an encysted Dropsy and Abscess of the Abdomen, and for such was opened; which either destroyed the Patient, or left a fistulous Sore that could not be cured. And he acknowledges, that he once was in Danger of committing

why the Colour of the Eyes and Urine ſo readily indicate the Preſence and Terminations of a Jaundice; why inflammatory, purulent, gangrenous and ſchirrous Diſorders of the Spleen, Stomach, Epiploon, Meſentery, and Inteſtines, always affect the Liver in ſo violent a Manner; and why, on the contrary, inflammatory and ſchirrous Diſorders of the Liver affect theſe Viſcera; why the Liver is ſometimes tumified, and augmented ſo prodigiouſly in Bulk; and why it is dried, and become friable, when the Fluids can no longer circulate through it: Why a Dropſy ariſes from Diſorders of this Organ, and ſometimes a Tympanum, of ſtill worſe Conſequence. For when the bilious Particles are not ſecreted from the Blood, and by the Liver, theſe Particles attenuate the Blood ſo extremely, as to make it tranſude eaſily through the Veſſels, and be accumulated in the Cavities of the Body; why, in a Dropſy, the Liver is ſo extenuated and dry, and the Spleen tumid: And, laſtly, hence we ſee the Nature of an hepatic Dyſentery, and an infinite Number of Circumſtances relative to Diſeaſes of this Kind. See BOERHAAVE's Aphoriſms.

OBSERVATIONS.

The Stomach hardly makes any Preſſure upon the Gall-Bladder, only by the contiguous Beginning of the deſcending Duodenum; but when the Stomach is extremely diſtended, and in a very full

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mitting ſuch a Miſtake. He had cut through the internal Teguments; and the Tumor beginning to ſubſide, made him immediately ſuſpect it to be the Gall-Bladder, and to deſiſt from the Operation. Soon after the Patient voided, by Stool, ſeveral Pints of Bile, and was cured. He ſays, that ſuch bilious Tumors may be diſtinguiſhed by a painful Tenſion about the hepatic Region, followed by a Jaundice with all its Symptoms, and by the Situation of the Tumor itſelf; which Symptoms, he ſays, generally appear; and, when duly conſidered, will lead us to gueſs at the real Diſtemper. Memoires de l'Acad. de Chirurg. Vol. I.

Abdomen,

Abdomen, it makes a conſiderable Preſſure both upon the Liver and Duodenum; by which the Gall-Bladder is urged, and its Bile expreſſed. Thus the Bile flows, through a free Paſſage, from the Gall-Bladder into the common Duct, and by that into the Duodenum; and this it does more eaſily in Perſons lying on their Backs: In which Poſture the Gall-Bladder does not flow back again into the Liver, appears from the Continuity of the Cyſtic and Ductus Choledochus, with the Angle that interrupts the Courſe from them towards the Liver, and the Reſiſtance of the new Bile, advancing forward from the latter. The expulſive Force of the Bile is but little more than that of the Preſſure received from the Stomach, Diaphragm, and abdominal Muſcles: For as to any muſcular Force reſiding in the Fibres of the proper Membrane, which may be thought to contract the Gall-Bladder, it muſt be very weak and inconſiderable. But the hepatic Bile continually flows this Way, even after the cyſtic Duct is tied, unleſs there happens to be ſome Obſtacle at the Opening of the Ductus Choledochus, which ſeldom continues long. Nor is it credible that all the Bile firſt paſſes thro' the Gall-Bladder, in its Way from the Liver, before it enters the Duodenum: For there is no perpetual Obſtacle or Reſiſtance to turn the Bile towards the Gall-Bladder, out of its Courſe into the Inteſtine. For the Way into the common biliary Duct is larger, and more direct; but the cyſtic Duct, being a great deal leſs than even the hepatic, cannot therefore be deſigned for receiving all the Bile which Nature intended to flow through thoſe ſo much larger Paſſages: Again, the Ductus Choledochus, being ſo much larger than either the cyſtic or hepatic, is, by the ſame Rule, deſigned to carry more than the Bile of either of them alone. In many Animals, the hepatic Duct conveys the

Bile

Bile into the Inteſtine, without any Communication with a Gall-Bladder, or a cyſtic Duct; and in other living Animals, where there is a free Communication with a cyſtic Duct, yet the Bile is found continually deſcending into the Duodenum. That the Quantity of Bile, ſo diſcharged, is very conſiderable, may appear from the Bulk of the Organ by which it is ſeparated, as well as the Magnitude of its excretory Duct * ſo many Times exceeding that of the ſalival Glands; and from Diſeaſes in which the Quantity of the cyſtic Bile only has, by an Ulcer of the Side, been let out equal to four Ounces at once.

The hepatic Bile is always bitter, but the cyſtic is more ſo; and both of them eaſily mix either with Water, Oil, or vinous Spirits, and are extremely well adapted to diſſolve oily, reſinous, or gummy Subſtances. It is inclined to Putrefaction; but, of itſelf, it naturally degenerates to a Muſk-like Odour. Its chymical Analyſis and Experiments of Mixture with various Subſtances, demonſtrate, that it contains a large Portion of Water, but a much leſſer of inflammable Oil, by near a twelfth Part; which, in Stones of a Gall-Bladder, appears very evidently; beſides which, there is no inconſiderable Portion of a volatile alcaline Salt. The Bile, therefore, is a natural Soap; but of that Sort which is made from a volatile ſaline Lixivium. This, therefore, being intermixed with the Aliment, reduced to a Pulp, and ſlowly expreſſed from the Stomach by the periſtaltic Force of the Duodenum, and Preſſure of the abdominal Muſcles, incorporates them all together; and the acid or aceſcent Qualities of the Food are, in ſome

* I have juſt now found the Pori Bilarii and hepatic Duct conſiderably larger than the Vena Porta; Hepatic and Veſicula Fellis leſs than this Duct.

measure, thus subdued; the Curd of Milk is again dissolved by it into a Liquid, and the whole Mass of Aliment inclined more to a putrid alcalescent Disposition. Like Soap, it dissolves the Oil or Fat, so that it may freely incorporate with the aqueous Particles, and make up an uniform Mass of Chyle to enter the Lacteals; the surrounding Mucus in the Intestines is hereby absterged and attenuated, and their peristaltic Motion is excited by its Acrimony; all which Offices are confirmed, by observing the contrary Effects, from a Want or Defect of the Bile. Nor would the hepatic Bile of itself be sufficient to excite the necessary Motion of the Intestines, without the stronger Action of the Cystic, both which are of so much Use and Importance to the Animal, that we find, by Experiment, even the strongest will perish, in a few Days, if the Flux of Bile be intercepted to the Intestines, by wounding the Gall-Bladder.

Thus it slowly descends along with the alimentary Mass, and, having spent its Force, or changed its Bitterness by Putrefaction, most of it is afterwards excluded, together with the Fæces; but, probably, some of the more subtil, watery, and less bitter Parts, are again taken up by the absorbing Veins, which lead to the Portæ of the Liver. It seldom returns up into the Stomach, because of the Ascent of the Duodenum, which goes under the Stomach, with the Resistance it meets with from the Valvulæ Pyloti, and the Advancement of the new Chyle, to which add the Force of the contracting Stomach itself. The Bile is indeed of a sweet soft Nature in the Fœtus; for in them the Fæces are not very fœtid, to supply putrid alcaline Vapours to the Liver; nor are there any oily or fat Substances absorbed from the Intestines.

As the Bile is a viscid Fluid, and thickens by Inactivity of Body in fat Animals, and in us from

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the ſame Cauſes, eſpecially when the Blood moves languid from Grief, &c. ſo it eaſily coagulates into a hard, ſomewhat reſinous, and often ſtony Subſtance; inſomuch that Stones of the Gall are much more frequent than thoſe of the urinary Bladder. When the excretory Paſſages are obſtructed by this Cauſe, or by a contrary convulſive Motion in the Ducts of the Liver, the Bile is, without much Difficulty, urged again into the Blood, which paſſes the Capillaries of the Porta into the Cava, as the Way is ſo pervious; whence all the Humours, and the mucous Body of MALPIGHI, become tinctured with its Colour, which forms a Jaundice. Whether or no the common biliary Duct is ever truly inſerted into the Pylorus. This, indeed, is an Obſervation publiſhed in the more uncultivated Ages of Anatomy, the Tradition of which has not been favoured by any of the more modern Anatomiſts; although we ſometimes read of its being inſerted near to the Pylorus. HALLER's Prim. Lin. Phyſiol.

OBSERVATION.

I know no Way of computing, with any Exactneſs, the Quantity of Bile that is uſually ſecreted by the Liver in a given Time: But if it is four Times as much as all the ſalivary Glands ſecrete, it may be twenty-four Ounces for every Meal; to which being added ſix Ounces of Saliva, I think this will appear a moderate Computation: And ſuppoſing the Pancreas, in the ſame Time, ſecretes three Ounces, there will then be

* In opening the Body of a Woman of a very good Habit, I found, in the Veſicula Fellis, the Bile concreted to the Bulk of a large Olive, of a mineral Colour; which was looked upon, by the ROYAL SOCIETY, to be the largeſt Concretion ever known to have been found in the Veſicula Fellis.

thirty-three Ounces of Fluids ſeparated for the Digeſtion of one Meal; and that theſe neceſſary Fluids may not be waſted in ſuch Quantities, they paſs into the Blood with the Chyle, and may be ſoon ſeparated again for the ſame Uſe; and, very likely, ſome of the ſame Bile may be employed, more than once, for digeſting Part of the ſame Meal. And as the Liver exceeds all the Glands, in the Body, in Magnitude, and its excretory Ducts ending in the Duodenum; it ſeems to me to be much more capable of making thoſe large Separations from the Blood which are procured by Cathartics, than the ſcarce viſible Glands of the Guts. The Liver ordinarily weighs, in a middle-ſized Man, about three Pounds twelve Ounces, the Pancreas three Ounces, and the Spleen fourteen Ounces.

I have ſeen a diſeaſed Liver, in a Man, which weighed fourteen Pounds, four Ounces; and in a Boy but nine Years old, who died hydropic, the Liver full of Hydatids, and Cyſts of Hydatids adhering to it, which, together, weighed ſeven Pounds, one Ounce and a Half, though ſeveral Pints of Water had been let out of it before. The Spleen in the ſame Boy, together with the Hydatids contained in its Membrane, weighed three Pounds.

In a Man I found a diſeaſed Spleen, weighing five Pounds, two Ounces; and in an old Man, ſix Feet high, I found a ſound Liver weighing no more than twenty-eight Ounces, and the Spleen but ten Ounces: And in a Man, who had been cured of a Dropſy, I found a Polypus very ſolid, almoſt filling the large Branches of the Porta in the Liver, and a Stone, between the Liver and Gall-Bladder, larger than a Nutmeg. CHESELDEN's Anatomy.

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LECTURE VIII.

Of the PANCREAS.

THE Pancreas is a long flat Gland, of that Kind which Anatomiſts call Conglomerate, ſituated under the Stomach, between the Liver and the Spleen. Its Figure reſembles that of a Dog's Tongue, and it is divided into two Sides, one ſuperior, the other inferior; two Edges, one anterior, the other poſterior; and two Extremities, one large, which repreſents the Baſis of a Tongue; and one ſmall, and a little rounded, like the Apex of a Tongue.

The Pancreas is ſituated tranſverſly under the Stomach, in the Duplicature of the poſterior Portion of the Meſocolon. The large Extremity is connected to the firſt Incurvation of the Duodenum, and from thence it paſſes before the reſt of that Inteſtine, all the way to its laſt Incurvation; ſo that a great Part of the Duodenum lies between the Pancreas and the dorſal Vertebræ. The ſmall Extremity is fixed to the Omentum, near the Spleen.

Structure of the PANCREAS.

The Pancreas is compoſed of a great Number of ſoft glandular Moleculæ, combined in ſuch a Manner, as to exhibit the Appearance of one uniform Maſs on the Outſide, the Surface of which is rendered uneven only by numerous ſmall Convexities, more or leſs flatted. When theſe Mole-

culæ are separated a little from each other, we find along the Middle of the Breadth of the Pancreas a particular Duct, in which several smaller Ducts terminate laterally, on each Side, like small Rami, in a Stern.

This Canal, named Ductus Pancreaticus, or Ductus Wirtsungi*, from the Discoverer of it in the human Body, is very thin, white, and almost transparent; and the Extremity of the Trunk opens commonly into the Extremity of the Ductus Choledochus: From thence it diminishes gradually, and terminates in a Point next the Spleen; the small lateral Branches are likewise pretty large near the Trunk, and very small towards the Edges of the Pancreas, all of them lying in the same Plane, like the Branches of the common Filix, or Fern.

The pancreatic Duct is sometimes double in Man, one lying above the other: It is not always of an equal Length, and sometimes runs in a winding Course, but always in the same Plane; and it is nearer to the inferior than the superior Side of the Pancreas. It pierces the Tunics of the Duodenum, and opens into the Ductus Choledochus, commonly a little above the prominent Point of the Orifice of that Canal; and sometimes it opens immediately into the Duodenum.

Pancreas Minus.

In Man I have observed, that where the great Extremity of the Pancreas is connected to the Curvature of the Duodenum, it sends down an Elongation, which adheres very closely to the following Portion of the Intestine; and, upon a careful Ex-

* George Wirtsungius, who first discovered this Duct in the Year 1642. which caused such Animosity among other Anatomists, that he was shot in his own Chamber.

amination,

amination, I found a particular pancreatic Duct, ramified like the large one, which ran towards, and interfected this great Duct, into the Extremity of which it opened, after having perforated the Duodenum. This Portion I term Pancreas Minus; and it fometimes opens feparately into the Duodenum; in which we likewife obferve feveral fmall Apertures, round the Ductus Choledochus, which anfwer to the Pancreas.

Sanguiferous Vessels and Nerves of the Pancreas.

The Arteries of the Pancreas come from the Pylorica, Duodenalis, and chiefly from the Splenica, which adheres very clofely to the whole inferior Side of the Pancreas near the poferior Edge; and it fends off, in its Paffage, a great many Rami, named Arteriæ Pancreaticæ, which go off from each Side, more or lefs tranfverfly. It receives alfo fome fmall Ramifications from the Gaftrica Major and Mefenterica Superior.

The pancreatic Veins are Rami of the Splenica, one of the principal Branches of the Vena Porta Major, or Ventralis. This Vena Splenica runs, likewife, along the inferior Side of the Pancreas, near the Edge, in a fhallow Depreffion formed in the Subftance of the Gland. Thefe Veins anfwer to the Arteries of the fame Name; and there are likewife other fmall Veins, correfponding to the fmall Arteries, which are Productions of the Mefaraica Major, &c.

The Nerves of the Pancreas come partly from the Plexus Hepaticus, partly from the Plexus Splenicus, and partly from the Plexus Mefentericus Superior; and it likewife receives fome from the flat ganglion or plexiform Intertexture mentioned in the Defcription of the Nerves, and called by the Name of the Tranfverfe Branch.

The pancreatic Duct is not only double in some Subjects, as has been said before, but the collateral Branches have Communications, in Form of Islands, in several Places within the Body of the Pancreas.

Juice of the Pancreas.

This Juice may cause many Indispositions. 1. If it remains too long in the Pancreas, it will alkalize, as all the Fluids of the human Frame. 2. If it is too abounding, it will retard the Action of the Bile; and therefore the fat Substances will not be able to dissolve. 3. If it is obstructed, the Bile will be too acrimonious, heat and rarefy the Air, and be able to cause Diarrhæas and Dysenteries.

It was formerly believed, that the Cause of intermittent Fevers was in the Pancreas; and the Opinion was grounded on its having been found, that this glandular Body was obstructed in Subjects who died of these Fevers: But it should have been proved before, that these Obstructions were not the Effect of Fevers. Certainly an obstructed Pancreas may be the Occasion of considerable Disorders: We may judge of it by the Quantity of Fluid which is there filtrated, and by its Necessity in Digestion. If the excretory Ducts be so closed as to permit no Fluid to go out, the Vessels will be more filled in the rest of the Body, which may inflame the Pancreas; on the other hand, the Duodenum will no more receive the Fluid which is necessary to dilute the Chyle, and precipitate the Excrements.

Observations.

The Quantity of Juice secreted by this Gland is uncertain; but it must be very considerable, if we compare the Bulk or Weight of it with that of the salival Glands, than which it is three Times larger,

and

and ſeated in a warmer Place. It is expelled, by the Force of the circulating Juices, with an alternate Preſſure from the incumbent and ſurrounding Viſcera; as the Liver, Stomach, Spleen, meſenteric and ſplenic Arteries, with the Aorta. The great Uſefulneſs of this Gland may appear, from its being found not only in Man, but in moſt Animals; nor is its Uſe the leſs, from that Experiment which ſhews that a great Part of it may be cut out from a Beaſt, unattended with any fatal Conſequences: For, by that Rule, the Animal, ſurviving after a Part of the Lungs are cut out, would render them equally uſeleſs; and beſides, in the Experiment, a Part of the Pancreas muſt be left with the Duodenum.

As to this Juice making any Effervescence with that of the Bile, that Notion has been ſo long exploded, as to need no farther Notice. HALLER.

MAURICE HOFFMAN firſt diſcovered an excretory Duct, compoſed of a Number of others, in the Pancreas of a Turkey, in 1641; and afterwards it was diſcovered by WIRTSUNGIUS in the human Body; as BARTHOLINE, who was preſent, informs us. This Duct is commonly ſingle in the human Body; ſometimes, however, it is double. In many of the common Birds it is double, and in ſome triple. Its Situation is in the Middle of the Pancreas, where it reſembles an empty Vein, and is of about the Thickneſs of a ſmall Straw. Its Termination is in the Duodenum. It enters it obliquely, four or five Fingers Breadth below the Pylorus, uſually at the ſame Orifice with the Ductus Choledochus; but ſometimes it has a double Aperture. In many Beaſts it is inſerted into the Duodenum, by a particular Orifice, at a conſiderable Diſtance below the Pylorus.

LEC-

LECTURE IX.

Of the SPLEEN.

THE Spleen is a bluiſh Maſs, ſomewhat inclined to red, and of a long oval Figure; being about ſeven or eight Fingers Breadth in Length, and four or five in Breadth. It is of a ſoftiſh Subſtance, and ſituated in the left Hypochondrium, between the great Extremity of the Stomach and the adjacent falſe Ribs, under the Margin of the Diaphragm, and above the left Kidney.

It may be naturally divided into Sides, Edges, and Extremities. It has two Sides; one external, and gradually convex; and one internal, which is irregularly concave: Two Extremities; one poſterior, which is pretty large; and one anterior, which is ſmaller, and more depreſſed: Two Edges; one ſuperior, and one inferior; on both which there are, in ſome Subjects, ſeveral Inequalities.

The interior or concave Side is divided, by a longitudinal Sciſſure, into two Planes or Semilaterals, one ſuperior, the other inferior; and by this Sciſſure, the Veſſels and Nerves enter in human Subjects. The ſuperior Semilateral is broader and more concave than the inferior; being proportioned to the Convexity of the great Extremity of the Stomach. The inferior Semi-

lateral

lateral lies posteriorly on the left Kidney, and anteriorly on the Colon; and sometimes this Side of the Spleen appears to have two superficial Cavities; one answering to the Convexity of the Stomach, the other to that of the Colon: The convex Side of the Spleen is turned to the left Ribs.

It is connected to the Stomach by the Vessels called Vasa Brevia; to the Extremity of the Pancreas by Ramifications of the splenic Artery and Vein, and to the Omentum by Ramifications which the same Artery and Vein send to the Spleen, and which run in the longitudinal Sciffure.

It is connected to the Margin of the Diaphragm by a particular membranous Ligament, of various Breadths in different Subjects, fixed on its convex Side sometimes near the superior Margin, and sometimes near the inferior.

This Ligament is situated transversly with respect to the whole Body, and longitudinally with respect to the Size of the Spleen: In some Subjects it is connected, by other Ligaments, to the Stomach and Colon; but in this there are considerable Varieties.

The Figure of the Spleen is not always regular, but is as various as its Size: Sometimes it has considerable Sciffures, both in the Sides and Edges; and sometimes it has Appendices. I have sometimes found a kind of small distinct Spleen, more or less round, and connected separately to the Omentum, at some Distance from the anterior Extremity of the ordinary Spleen.

Structure of the SPLEEN.

This is not easy to be unfolded in Man; and it is very different from that of the Spleen in Brutes.

Its Coverings adhere so closely to it in Man, that it is difficult to distinguish the common from the

the proper Membrane; whereas in ſome Brutes, ſuch as Oxen, Sheep, &c. nothing is more eaſy: For in ſuch Animals we find two Membranes, ſeparated by a cellular Subſtance. This Covering ſeems to be no otherwiſe a Continuation of the Peritonæum than by the Intervention of the Omentum and Meſocolon; and even in Man, the two Membranes may be diſtinguiſhed, where the Veſſels enter by the longitudinal Sciſſure.

In Man, the Subſtance of the Spleen is almoſt vaſcular, that is, compoſed of the Ramifications of all kinds of Veſſels: In Oxen, the Subſtance of the Spleen is chiefly reticular; and in Sheep, it is cellular. In Oxen and Sheep, there are no venal Ramifications, but, inſtead thereof, only open Sinuſes, diſpoſed like Branches, except a ſmall Portion of a venal Trunk, perforated on all Sides, at the Extremity of the Spleen.

In the human Spleen we ſee ſomewhat like glandular Corpuſcles, as in thoſe of other Animals; and there are numerous venal Ramifications thro' its whole Extent: Between theſe Ramifications we every-where obſerve an Appearance of extravaſated Blood, lying in a kind of filamentary tranſparent and very delicate Subſtance expanded through the whole Spleen.

This filamentary Subſtance, having ſurrounded all the Ramifications, terminates in almoſt imperceptible Cells, which communicate with each other ſo, that if we blow through a ſmall Aperture, made in the membranous Covering, the whole Spleen will be immediately inflated.

The Surface of the Spleen of Oxen and Calves is viſibly full of a great Number of lymphatic Veſſels, which may, at any Time, be eaſily demonſtrated; but in Man, it is a very difficult Matter either to diſcover or demonſtrate them.

SAN-

Sanguiferous Vessels and Nerves of the Spleen.

The splenic Artery, which is one of the principal Branches of the Cæliaca, runs along the inferior Side of the Pancreas, as has been already said, and passes from thence, in a winding Course, to the Spleen. The splenic Vein, which is larger than the Artery, is but little inflected in this Part of its Course.

This Artery and Vein, having got beyond the Extremity of the Pancreas, send out several Rami together, which immediately afterwards divaricate in the same Plane, run in the membranous Duplicature of the neighbouring Portion of the Omentum, and, lastly, intersect each other, in their common Plane, all the Way to the Sciffure of the interior or concave Side of the Spleen.

These arterial and venal Rami enter the Substance of the Spleen, together, by the same Sciffure; being accompanied by the cellular Substance belonging to the membranous Duplicature of the Omentum. We may likewise observe, that at this Place the Membrane of the Spleen sends from its concave Side a Portion of a Lamina, which is incurvated in the Sciffure, and penetrates into its Substance.

The Nerves * of the Spleen are very numerous, and come from the Plexus Splenicus, already described: These Nerves send out, at different Distances, round all the arterial Ramifications of the Substance of the Spleen, a great Number of Filaments in Form of an irregular reticular Texture.

The Arteries, Veins, and Nerves, having entered the Spleen, are there divided and subdivided

* They are so very small, that they are capable of but little Sensation; therefore rarely inflamed. Vid. Haller's Physiolog.

into

into a great Number of Ramifications, and accompany each other to the very Extremities of their Diviſions. They are contained in a kind of common cellular Capſula or Vagina, which firſt ſurrounds all the three, and then ſends off particular Septa between them. This Capſula ſeems to be formed by a Continuation of the cellular Subſtance of the Omentum, and of that particular Lamina of the Membrane of the Spleen before mentioned.

The capſular Extremities of all theſe vaſcular Ramifications, both arterial and venal, end in the filamentary Cells already mentioned. MALPIGHI conſidered them as diſtinct Capſulæ or Folliculi, containing the ſame Number of ſmall Glands: They all communicate together ſo, that wherever we pierce the Membrane of the Spleen, we may, through that Aperture, inflate the whole Viſcus.

In Oxen and Sheep there are no venal Ramifications, as I have ſaid. The Vena Splenica, having entered the great Extremity of theſe Spleens, runs firſt of all for about Half an Inch or an Inch, and afterwards, inſtead of an ordinary Vein, we find a Canal perforated on all Sides. The Beginning of this Canal has ſtill ſome Remains of the Coat of a Vein; but the Form of it is ſoon loſt, and then we find nothing but Sinuſes, or Sulci, in the reticular Subſtance in Oxen, and in the cellular Subſtance in Sheep.

The ſplenic Artery and Nerves are there ramified in a particular Vagina, as in Men; and the Extremities of theſe arterial Ramifications ſeem to ſwim or float in the Cells, and to fill their filamentary Subſtance with Blood. At the Ends of ſeveral of theſe Capillaries I have obſerved ſmall Corpuſcles, diſpoſed like Bunches of Grapes; and I have ſeen two ſmall Tubes going out from each Corpuſcle, one long and open, the other ſmall and ſhort, which was loſt in the Sides of the Spleen.

I imagine that the long Tube, the Extremity of which I was not able to find, may be the Origin of a lymphatic Veſſel, eſpecially becauſe theſe Veſſels are ſo very numerous and viſible in an Ox's Spleen, as has been already ſaid. Theſe ſmall Corpuſcles may eaſily be diſcovered in an Ox's Spleen, when boiled by a particular Adminiſtration, of which I ſhall ſay more in another Place. They are indeed much larger before than after boiling, but they are not ſo ſolid, and ſubſide more eaſily when cut. The ſame Sort of Corpuſcles may be diſcovered in the human Spleen; but they are ſo extremely ſmall, as not to be viſible without a Microſcope.

Various Conjectures on the Uſe of the SPLEEN.

Since the Spleen ſeems to be ſubſervient to the Liver, we ſhall now examine the Uſes of it. It has been looked upon, for a long Time, as an unprofitable Part, which Nature had placed, in the left Hypochondrium, as a Counterpoiſe to the Liver. Perhaps they*, who have ſucceeded, have been confirmed in this Opinion, from what PLINY relates, upon the Credit of his Cotemporaries.

This moſt eloquent Naturaliſt aſſures us, that the Spleen is a great Hinderance to Running; but by ſeveral Experiments, made ſince his Time, by taking it away from ſeveral Animals, this Error has been detected.

A famous Practitioner † boaſts, that he took away from a Woman a Spleen which weighed two Pounds. Another ‖ ſays, this Operation was performed, in his Time, by two Surgeons; who aſſured him, that they were obliged to take away the Spleen from two Perſons who had received a deep

* DEMOCRIT. ERASISTRATUS, RUFFUS, EPHESIUS, &c.
† FIORIVENTI. ‖ ROUSSET.

Wound

Wound in the left Hypochondrium, by which the Spleen came out. The like Inſtances are to be met with in the Works of other practical Writers *. Beſides, it is known, that Dogs, after the Spleen is taken away, are cured in a ſhort Time; and that they grow fatter, and are always eating; piſs often, and follow the Bitches alſo more eagerly. This Operation having been made on two Dogs, they opened them, ſix Months after, and the Bile was found to be like coagulated Milk. The ſame has alſo been obſerved in Dogs whoſe Spleens were not taken away. Though Animals are cured, in a ſhort Time after the Spleen has been taken out of them; we muſt not thence conclude, that it is uſeleſs. Is it not well known, that the Teſticles, Omentum, &c. are taken away, without Danger, or Riſque of the Animal's Life? The particular Structure of the Spleen, the Connection it has with other Viſcera, and the Indiſpoſitions which it cauſes, when diſordered, ſufficiently convince us, that it is of great Uſe in the Body. It is long ſince it was known † to be no Parenchyma: The Subſtance of it is only a Heap of Fibres and little Cells, like thoſe in a Bee-hive. Theſe little Cells are made by the Ramification of the venal Duct, as the little Veſicles of the Lungs are formed by the Branches of the Aſpera Arteria, which are thin and ſlender. Some have obſerved, that there are certain ſmall Glandules, which fill up theſe little Cells of the Spleen, that they ſometimes lie in Heaps cloſe to each other, but are alſo often ſeparated from each other; the Branches of the Arteries and Veins are ſenſibly diſperſed there; they are leſſer in Man than in Sheep; and yet, in a Calf, they immediately appear, as ſoon as the Membranes are taken away;

* The German Journals, and Dr. BONET.

† Vid. VESALIUS, HIGHMORE, GLISSON, and MALPIGHI.

away; and that the Spleen is well washed by syringing the two Vessels.

It is well known, that the Spleen has no excretory Duct: There are a Million of little Branches from the Trunk of the Arteria Splenica, which form a kind of reticular Texture in the Spleen: Some go to the Glandules, and to these Coverts or Cases: In fine, there are also others which empty themselves immediately into the venous Sinus.

It is difficult to trace out these Branches even to the Glandules. An Injection goes a great Way into the more sensible Ramifications; but it passes no farther. But Reason tells us, that there must be some Communication between the smallest Branches and the Cellulæ: For the Spleen having no excretory Duct, all the Blood which passes into this Part, or Viscus, must needs be immediately poured through the Branches of the Arteries into all the Cellulæ. And it is not only the more subtil Liquors which may pass into these little Cells, but also Wax, by syringing the Arteria Splenica, upon the Supposition of this Structure. I hope it will appear no longer a Paradox, that the Arteria Splenica is so much bigger than the Arteria Hepatica; because the Blood, which passes to the Spleen, is not poured into small Spaces, as it is in the Liver; but it enters into a great many Cellulæ, which being collected, would make a large Cavity. Therefore the Spleen required a larger Duct than the Liver, that it might receive more Blood.

The Arteria Splenica has always a Vein with it, but there is no Anastomosis betwixt these Vessels, as many * Anatomists have said. They are all covered with a Capsula, through which the two Nerves, which belong to each Branch of the Ar-

* Bartholinus, Highmore, and Diemerbroeck.

tery, pass, which are also insensibly spread through the Spleen.

The Spleen is a Viscus which is very subject to Obstructions; because, being altogether of a spongy Substance, the Blood may easily enter there. If the Return of the Blood is any ways hindered, an extraordinary Pulsation in the left Hypochondrium may very sensibly be perceived.

Practical Authors * have many Instances of this Kind. It is sometimes attended with Vomiting, and evacuating Blood also by Stool.

A Man was dissected who was thought to be poisoned, having died, in a short Time, of an extraordinary vomiting of Blood. The Ventricles of the Heart and Vasa Major had no Blood in them; on the other Side, the Stomach and Intestines were full of it. The outward Membrane of the Spleen was hard and callous, but the Substance of it was very soft; there was no Blood found in the little Cells of it. In fine, they found all the Liver schirrous, which caused a Conclusion to be drawn that he was not poisoned, but that he died of the rising or ascending of the Blood into the Arteria Splenica, which was occasioned by the Schirrus of the Liver.

As to the lymphatic Vessels of the Spleen, we shall observe, that they do not run through the Membrane, but enter into the Substance of it as far as the small Glandules. It is impossible to pursue or trace out the Progress of them, either by Dissection or Injection; because the Blood, which flows from the Vessels, happening to be lacerated on this Occasion, hinders us from inspecting them.

The Spleen has been looked upon, by some, as the Source of Melancholy; others have said that it

* Tulpius Sepulchretum Bonet.

served

ſerved to ſeparate ſome kind of laudable Liquor. The firſt who will have it that the Spleen ſeparates the more terreſtrial and groſs Particles of the Blood from the other pretend, that theſe Impurities are retained by the Subſtance of it. This Opinion is eaſily confuted: For the Blood, which paſſes to the Spleen, is no way different from that which circulates to other Parts. Beſides, when they aſſert that the Spleen is the Seat of Melancholy, it may be aſked, Where is the Veſſel to contain it? Is the Spleen a Veſſel, like the Bladder, wherein the Gall is contained? We cannot ſay that the Vaſa Brevia, and the hæmorrhoïdal Veins, are the Sink for receiving this Excrement; ſince theſe ſhort Veſſels ſerve for nothing elſe but to bring and carry back the Blood. As to the hæmorrhoïdal Artery; ſince that is only a Branch of the inferior Arteria Meſenterica, it would be ridiculous to make it the excretory Duct of Melancholy.

Others have imagined, that the Canalis Pancreaticus was the excretory Veſſel of the Spleen. Some of the Moderns have aſcribed this Office to the lymphatic Veſſels. As to this Melancholy, ſo much inſiſted on by the Antients; we know not, as yet, what Idea they had of this Word; ſince there is nothing terreſtrial in the Spleen; and that the Blood, which comes there, is like that of the other Parts, as was before obſerved. Beſides, thoſe * who pretend that the Spleen ſerves to ſeparate ſome uſeful Juice or Liquor, are as much miſtaken as the others, whether they agree with ſome, that the Spleen makes the Blood; or with others, that it prepares an Acid for Digeſtion.

The Followers † of ARISTOTLE, in this Point, are very numerous: They have all looked on the

* ARISTOTLE, ARITAUS, HELMONT, and WALÆUS.
† BAUCHINUS, PLATERUS, SPIGELLIUS, and CASP. HOFFMAN.

Spleen as a ſecond Liver, which ſerved to make Blood.

An eminent Author ſets forth all their Reaſons more at large, and adds others, which we have anſwered, by ſhewing the Abſurdity of this Theory. As to that Opinion * about the Acid of the Spleen, it contradicts Experience; ſince we find thoſe Animals, which have been deprived of their Spleen, have a better Appetite and Digeſtion.

There are others † who aſſert, that the Spleen perfects the Blood by communicating certain Spirits to it, as it paſſes into this Part. They ſay alſo, that the prodigious Number of Nerves which are ramified in the Spleen, by the ſeveral Turnings or Windings which they make, produce abundance of Spirits, which, by mixing with the Blood, do exalt and ferment it; whence the Chyle is the ſooner turned into Blood. This Opinion is confuted by Experience; ſince it is not certain that the Nerves convey any Juice: Beſides, we ſhall make it appear that the Uſe of the great Number of Nerves in the Spleen was unknown to them. For the Reaſon why there are ſuch great Ramifications in the Spleen is, to prevent the Blood's remaining too long in thoſe little Cells, with abundance of animal Spirits; whence their Spring is ſtrong enough to drive out the Blood from thoſe venal Cavities.

In fine, it has been ſaid, that thoſe Dogs, whoſe Spleens have been taken from them, are more briſk, nimble, hungry, piſs oftener, and are alſo more eager after Bitches, than others; which indicates, that it is not the Spleen which contributes to the Acidity of the Blood.

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* Highmore and Malpighi.

† Sylvius, De la Boe, & Velthupius.

Dennis,

DENNIS, in his Diſſertations, which he preſented to the Dauphin, ſays, that the Spleen ſerves to thicken the Blood, and give it a certain Conſiſtency, which prevents its being too precipitate in its Courſe, or being too ſubtil. But as he does not diſcover the Cauſe of the too great Effervescence of the Blood, we ſee no Neceſſity for its being condenſed.

To ſay ſomething, at preſent, that may be more ſatisfactory, on the Uſe of the Spleen, we ſhall firſt ſet down the Opinion of MALPIGHI, which he delivers only as a Conjecture which came into his Head. After the Examination of this Part, he ſays, that it is very probable, that the Blood, which paſſes into the Spleen, may there receive ſome Alteration, which may make it ſomewhat different from what it was before it came there; becauſe it paſſes not into the Spleen after the ſame Manner as it does into the other Viſcera, in croſſing through the little Tubes, and ſmall Cells, which form the capillary Branches of the Veins and Arteries. But the Blood which circulates in the Spleen, after it has paſſed through the Arteries and Glandules, is received into the larger Sinuſes or Cavities, and greater Cells; where, by its ſtaying there ſome Time, it is ſo modified, as to be able to change the Blood which it meets with in the Vena Porta; ſo that the Blood, which is diſtributed in the Liver, is better diſpoſed to be ſecreted, in order to ſupply Matter for the Bile.

There are ſome who pretend, that there is a Communication between the Spleen and the Liver, from this; that, after the Spleen is taken away, the Liver grows bigger. This Phænomenon is not always true; ſince the Liver does not conſtantly increaſe in thoſe Dogs which have been deprived of their Spleen. If the Liver has ſometimes been found bigger upon the Extirpation of

the Spleen, it is not becauſe the Arteria Hepatica, in that Caſe, did carry more Blood into the Liver.

Another Obſervation, which is more certain and important than the firſt, and which ſhews that there is a Communication between the Spleen and Liver, is, that the Bile is always found coagulated, in the Veſicula, the next Day after the Spleen is taken away: Hence we may infer, that the true Uſe of it is, to diſpoſe the Blood ſo, as to be more eaſily ſeparated in the Liver, for the Formation of the Bile. Yet here ariſe two Difficulties, which may be objected againſt this Syſtem. 1. Some, perhaps, may ſay, that, after the Spleen is taken out of a Dog, the Bile is ſtrained in the Liver as it uſed to be. 2. That the ſmall Quantity of Bile in the Glandules of the Veſicula is not derived from the Blood of the Ramus Splenicus; ſince that has no farther Communication with the Veſicula. We anſwer the firſt Difficulty by ſaying, that though it be true that the Bile is ſecreted in the Liver, as before deſcribed; yet this may proceed from another Cauſe; viz. that there is more Blood derived there, when the Spleen is taken away; and this Abundance of Blood may ſupply the Defect of this Part, which would have given the Blood the Alteration it uſually receives.

It is alſo from this great Quantity of Blood that Animals, which have loſt their Spleen, do piſs ſo often, and are more greedy and ſalacious than others. For as there paſſes a greater Quantity of Blood through all the Viſcera, the Secretions of it are much more copious; therefore the Diſſolvent of the Stomach, which is nothing elſe but a Lympha filtrated through the Glandules of the Membrane, is more plentiful. The Teſticles alſo muſt needs ſecrete more Semen, and the Kidneys more Urine. The Caſe is the ſame with the reſt of the Glands, where the Spleen ſtill remains.

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One may, in a Manner, obſerve the ſame Changes after drinking freely; which proceeds purely from Fulneſs of the Blood, which is plentifully ſecreted through the Glandules, being overloaded with Seroſities. The other Difficulty is eaſily anſwered; ſince the arterial Blood, though there were no Spleen at all, is alſo ſecreted in the Liver, as well as the Lympha is in the Glandules of the Veſicula Bilis.

The greateſt Portion of the Blood, which paſſes into the Spleen, is received into its little Cells; and a ſmall Quantity of it ſecreted through the Glands. As the greateſt Part of the Blood paſſes not thro' narrow Channels, but is poured out into large Spaces; it remains ſome Time in thoſe little Cells before it circulates: So this Return of the Blood not any-ways anſwering the Impulſe of the Heart and Arteries, perhaps a fourth Part of the Blood is not driven from the Spleen at each Pulſation of the Heart. Thus we ſee, that, before all the Blood leaves the Spleen, many Pulſes are required. During all theſe Intervals, the Blood, which remains in the Cellules of the Spleen, muſt undergo ſome Alteration, but not by Secretion, as the Spleen does not ſecrete any Liquor, not having excretory Ducts, at leaſt not yet diſcovered. If it ſo happens, that the Blood is any ways changed in the Spleen, it is becauſe, being of a ſpongy Nature, it is there ſqueezed, as in a Sponge; as the Cellules of the Spleen are not always of the ſame Bigneſs. Since they often change their Figure, becauſe they are formed of certain Mambranes which have a great Number of Nerves ſpread all over them, which puts them continually in Action.

The glandulous Parts of the Spleen make no particular Secretion, as MALPIGHI ſays; who believes, that they filtrate a brackiſh Liquor, which is mixed with the Blood of the Cellules, in order

to diſſolve it, by which it is better diſpoſed to leave its bilious Particles in the Liver. But as the Glandules of the Liver have no excretory Ducts, they differ no ways from other conglobular Glandules. Their true Uſe is only to ſecrete the Lympha, which returns by the lymphatic Veſſels, into the Receptaculum Chyli, if theſe Glandules ſhould ſecrete any acid Juice, as ſome imagine; it would rather coagulate than diſſolve the Blood; ſince Experiments demonſtrate, that Acids coagulate Blood, Milk, &c.

There are ſome Perſons of Credit who ſay, they have extracted, by way of Analyſis, an acid Salt from the Spleen. If that be true, we muſt ſuppoſe that the Fire had produced it, by changing the Particles of the mixed Subſtance; which proves that the Salt was not one of the Principles of the Spleen. Is this what they maintain? That this Salt being put into Blood, or Milk, coagulates them; yet the Spleen, being infuſed in Milk, does not coagulate, nor even when boiled in it.

In ſhort, to make an End of our Conjectures on the Uſe made of the Spleen; many Experiments confirm what we have ſaid, in the Spleens of all the living Animals which have been examined; the Blood of which was never found to be thick, or viſcous; but, on the contrary, rather more fluid and thinner, than in any other Parts of the Body.

If we make a Ligature at the Vena Splenica, and take Care not to tie the Artery, and afterwards put the Spleen in its Place again, and ſew up the Wound; in about two Hours after, if we take the Spleen out again, we ſhall find it full of a lively red Blood, provided the Animal be ſtill living. This fine ſcarlet Colour returns pure into the Blood, becauſe it cannot get out of theſe little Cellules of the Spleen: It is ſo ſtrongly preſſed, that the Particles of it are violently turned about

their

their Center with a circular Motion; and the Blood, which the Arteries drive thither afresh, makes the Blood also turn round in the Spleen; because, by entering all at once, and not being able to get out; all these Particles beat against one another, as they pass from these little Cells to others; this makes them also turn, with a rapid Motion, just in the Manner as the Blood which passes into the Cellules of the Lungs, by its circular Motion; which renders it so red.

The Blood, which is taken from the Spleen, remains, for a considerable Time, of a florid Colour, fluid, and is a longer Time before it coagulates, or the Lympha is separated from it; and proves very sweet to the Taste: On the contrary, that Blood, which is taken from the Vein, is presently coagulated; and, in less than an Hour's Time, the Serum is separated from it. VERDUC on the Uses of the Parts of the human Body.

Now the most commonly received Opinion of the Fabric of the Spleen appears to be much more simple than has been commonly believed: For it is composed, both in Man and Calves, altogether of Arteries and Veins; the former of which, after spending themselves in a great Number of small Branches, are at length thickly subdivided into very soft Brush-like Bunches, very difficult to fill by Injection; terminating in Circles, by which there is a ready Passage for Liquors into the corresponding Veins. These Circles, with their parallel Branches, form a sort of Bunches like a Pencil Brush, but of a shorter rounder Kind; whence many have mistaken them for Glands. Nor does the Injection, rightly managed, ever escape from the Vessels into the cellular Substance; besides which, there are no other Cells or Intervals. Every little arterial Trunk, with the small Twigs which proceed from it, are each of them surrounded

rounded by a very fine cellular Subſtance, in the ſame Manner as the ſmall Veſſels of all the other Viſcera; and theſe, together, form the whole Subſtance of the Spleen, ſurrounded by a thin Membrane, which is a Continuation of the Peritonæum.

Hence we obſerve, that the Spleen contains more Blood, in Proportion, than any of the other Viſcera; ſince it has no Muſcles, Fat, Air-Veſſels, or excretory Ducts, interpoſed betwixt its Blood-Veſſels. We learn, alſo, from Obſervation, that the Blood of this Part hardly ever congeals; from the Abundance of its volatile or bilious Salts: But it looks of a dark brown Colour, and may be eaſily diluted; whence one may compare it almoſt to the Blood of a Fœtus.

The Want of an excretory Duct to the Spleen, has occaſioned the Uſe of it to be doubtful, and controverted throughout all Ages of Anatomy. To us the Fabric itſelf ſeems to lead to the Uſe following: We ſee by the Veſſels a greater Quantity of Blood is imported to the Spleen, and with a ſlower Motion, from the ſerpentine Courſe of the Artery; but, at the Time when the Stomach is empty, this Blood comes, and is reckoned in a greater Quantity, by the Spleen, not now ſo much compreſſed, therein to ſtagnate, as it would ſeem, plainly from the great Proportion of Branches, to the Trunks in this Part; to which add, the difficult Courſe, or ſlow Circulation, which the Blood meets with in paſſing from the Spleen through the Liver. From hence the frequent Tumors and Schirroſities of the Spleen; and hence the immenſe Quantity of Blood with which the Spleen is impregnated; the like of which we do not ſee in any other Part. Here, then, the almoſt ſtagnant Blood, fermented with Heat, attenuated, and, in a Manner, diſſolved by the putrid Fæces of the adjacent Colon, enters thus upon the firſt Steps of

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a begun Putrefaction, as we learn by Experiments, both from its Colour and Conſiſtence. But the greater Fluidity of the Blood herein, proceeds not only from this Diſſolution, but becauſe all its aqueous Particles, which enter by the Artery, return alſo again by the Vein; for there are no ſecretory Ducts in the Spleen.

Beſides, when the Stomach is full of Food or Flatus, the Spleen is thereby compreſſed into a narrower Compaſs againſt the Ribs, and ſuperincumbent Diaphragm; by which means the Blood, that before was ſcarce able to creep along through the ſplenic Veins, being now preſſed out more plentifully, returns with a greater Celerity towards the Liver, till, mixing with the ſluggiſh Blood in the Trunk of the Porta, repleniſhed with the Fat, or Oil of the Omentum and Meſentery, it dilutes or thins the ſame, and renders it leſs apt to ſtagnate or congeal; and, at the ſame Time, it conduces to form a larger Secretion of Bile, at a Time when it is moſt wanted; viz. to flow plentifully to the Food now under Digeſtion. The Spleen, therefore, ſeems to prepare the Blood, that it may ſupply a ſort of aqueous Fluid to the Bile; but ſuch as is probably of a ſubalcaline Nature, and rendered ſomewhat ſharp, or lixivial, by the Sejourn of the Blood.

Hence we may be able to ſolve the Queſtion, Whether the Spleen be like the Lungs of a ſpongy or cellular Fabric? and whether the Blood is poured out into thoſe Cells, ſo as to ſtagnate in its Way to the Veins? or whether it be there diluted with ſome Juice ſecreted by peculiar Glands? We ſee nothing of this is demonſtrable by Anatomy; nor does the Liquor or Wax injected ever extravaſate into the cellular Subſtance, unleſs urged with much greater Violence than Nature ever uſes, or intended. If it be aſked, Whether Diſeaſes do

not

not ſometimes demonſtrate a ſort of glandular Fabric in this Part; and comparative Anatomy the ſame? As to the old Queſtion, Whether the Spleen prepares an Acid to ſtimulate the Stomach? that Opinion has been long rejected, as repugnant to the Nature of all the animal Juices.

If it be aſked, Whether the Spleen be not an uſeleſs Maſs, as it might ſeem to be, from the little Damage an Animal ſuſtains, after it has been cut out? We anſwer, That a robuſt Animal, ſuffering but little Injury from the Loſs of a Part, does not prove it to be uſeleſs: On the contrary, we find, after ſuch an Experiment has been made, that the Liver becomes ſwelled and diſordered, makes a leſs Quantity of Bile, and of a darker brown Colour, whilſt the Animal is perpetually troubled with Flatulencies, Gripes, or Indigeſtion; all which are to be aſcribed to the vitiated Nature of the Bile, Obſtruction of the Liver, and an imperfect or weak Digeſtion, HALLER's Prim. Lin.

OBSERVATIONS.

We read, in Cent. I. Obſerv. LIX. of STEPH. BLANCHARD, that he found in a Subject the Spleen weighed eight Pounds; the interior Subſtance full of black Matter like Pitch. Alſo, in Cent. II. Obſerv. XII. he likewiſe met with a Spleen of an immenſe Magnitude, and hard; the inferior Part whereof, towards the Ileum, was round, and full of black Blood. The Artery and Vein were about Half an Inch in Diameter.

HILDANUS relates, that he has ſeen the Spleen ſo tumified and large, as to reach the internal Surface of the Os Pubis.

Sometimes it is divided into ſeveral Portions, ſo as to be taken for diſtinct ones. In a Man of a good Habit, aged about Forty Years, the Spleen weighed

weighed Thirty-two Ounces; being nine Inches in Length, and five in Diameter; no way disordered, but in an intire perfect State: The other Viscera was not disproportionable to the Man, who was about five Feet six Inches in Height; an Account of which, with a Drawing, I gave to the ROYAL SOCIETY.

We read, in the Histoire de ACAD. ROYAL DES SCIENCES, in the Year 1700, that Dr. LITTRE, Anatomist to that ROYAL ACADEMY, presented to them the Spleen taken out of a Man aged Sixty Years, which was petrified; with the Membrane of another ossified. The Man was no way disordered in his Life-time.

As the real Use of the Spleen is not yet well known, it has occasioned a great many Hypotheses, not only by the antient Anatomists, who looked upon that Viscus as useless in the Body, which they have extracted from several Animals, and, in some Disorders of the human Spleen, they used to burn it, according to the Manner of their Practice; even some of the Moderns would persuade us, that the Spleen may be extirpated out of the human Body with Safety. I do not know that any Author has taken more Pains than Sir RICHARD BLACKMORE on that Viscus, in his Critical Dissertation, to endeavour to prove, from various antient Authors, that the Extirpation of it was practised in those Days, nay, even now, in Persia. But when we reflect on our modern anatomical Knowledge, I think no Man would be so rash as to attempt such an Operation. As for those Physicians who have accused this Viscus, as well as the other Viscera, of many Diseases, which very often, upon Dissection, prove groundless: I am apt to think, with C. AURELIANUS, that the human Spleen has oftener been amputed with the Tongue, than otherwise.

LEC-

LECTURE X.

Remarks on the Deſcription and Uſes of the INTESTINUM DUODENUM.

Taken from Profeſſor ALEXANDER MONRO's Medical Eſſays, Vol. IV. Art. 11.

THE Deſcription and Draught of the Inteſtinum Duodenum, as given by moſt Anatomiſts, appearing faulty *, has occaſioned this Paper, to rectify their Omiſſions or Miſtakes.

From the Pylorus, which is raiſed upwards and backwards from the Stomach, the Duodenum deſcends obliquely to the right Side, with the anterior Lamella of the Omentum, fixed to its inferior Part, and the little Omentum, proceeding from the oppoſite Part, to connect it to the Liver: After this the Duodenum is involved, for about an Inch and a Half, in a Duplicature of the Omentum, and then enters into the Duplicature of the Meſocolon, where it cannot be ſeen without diſſecting away that fat Membrane. It deſcends, in this cellular Sheath, till it is almoſt contiguous to the great Sac of the Colon, which properly is the human Cæcum. In this Deſcent the Colon lies before it; the biliary Duct, hepatic Ar-

* One would be apt to think that ingenious Profeſſor had not read our learned and exact Anatomiſt Dr. WINSLOW, or elſe got the Deſcription of the Duodenum given by him: However, the Reader may judge who deſerves beſt.

tery

tery and Nerve, Vena Porta, and emulgent Veſſels, are behind it. The Liver, Gall-Bladder, and right Kidney, are on its right Side; and the Pancreas is on the left. This Inteſtine makes ſeveral Turns in this Progreſs; for it is raiſed into a Convexity forwards, where it paſſes before the Veſſels of the Liver: Immediately after it bends backwards, and to the right Side, till it approaches the right Kidney, and then turns forward, and a little to the left, in its Courſe towards the great Sac of the Colon. The Duodenum then makes a conſiderable Curve to the left Side, where it is involved in a cellular Subſtance, which may be looked on as the common Root of the Meſentery and Meſocolon, through the Membrane of which it may be commonly ſeen. In the left concave Side of this Curve, the thick Extremity of the Pancreas Major and Pancreas Minor are lodged; the ſuperior meſenteric Artery and Vein, coming through the Sciſſure between the larger and leſſer Pancreas, hang looſe before the Inteſtine here; and the Ductus Communis Choledochus, after paſſing behind the Inteſtine a little higher, unites commonly with the pancreatic Duct, a very little above the loweſt Part of the Curve; and, after paſſing obliquely through the Tunics of the Inteſtine, the two Ducts open, by one common Orifice, in the poſterior Part of the Duodenum. After the Curve juſt now deſcribed, the Duodenum is involved in the Root of the Meſentery, and aſcends obliquely within it, towards the left Side, with the Vena Cava behind it; and, after a Courſe of about four Inches, riſes forwards to acquire a proper Meſentery, or to commence the Jejunum, the Membranes of the Root of the Meſentery ſeeming to make a Ring, at which the Inteſtine comes out, though they are really continued

nued on the Inteſtine, and form its external membranous Tunic.

That all the Duodenum may be expoſed to View, without changing its natural Situation, in a Body lying ſupine, it is neceſſary to cut through the great Arch of the Colon, below the Bottom of the Stomach, and, after turning the cut Extremity of the left Side over, on the left ſhort Ribs, to take hold of the other Extremity of the Colon; and having ſeparated it, with a Pair of Sciſſars, from the Stomach and Liver, taking away with it as much of the Omentum and Meſocolon as obſtruct the View of the Duodenum and Pancreas, to lay it likewiſe on the right Loin.

When the Colon is removed, obſerve where the Roots of the Meſentery and Meſocolon prevent your ſeeing the Courſe of the Duodenum; at ſuch Places cut theſe Membranes with a very ſharp Scalper, directing the Inciſions according to the Length of the Inteſtine, and then cautiouſly ſeparate the Membranes to each Side, till all the Inteſtine is in View: Laſtly, draw the ſmall Inteſtines gently down, raiſe the Liver, and ſuſpend the Fundus of the Stomach as much as is neceſſary to allow a full View of the whole Courſe of the Duodenum.

From this Deſcription of the Duodenum, it appears, 1. That ſince it is involved in the cellular fat Subſtance of the Omentum, Meſocolon, and Meſentery, and is not braced into a firm Membrane, as the other Inteſtines are; it muſt more eaſily yield to any diſtending Force: And having the whole Subſtances thrown into the Stomach with the Bile and pancreatic Juice poured into it, it muſt receive more than any other Inteſtine; and then whatever enters it muſt go out with ſome Difficulty, becauſe its Extremity, next the Jejunum, is fixed in a Courſe almoſt perpendicularly upwards.

upwards. Upon the Whole, it is no Wonder that this Inteſtine is frequently found ſo large as to be called Ventriculus Succenturiatus.

2. The aſcending Courſe of the Extremity of this Inteſtine, and the Influx of the Bile and pancreatic Liquors into the moſt depending Part of it, where the Food makes the longeſt Stop, are wiſely contrived both for the more eaſy Influx of theſe Liquors, and for a ſufficient Quantity of them being mixed with the Food.

3. A pendulous Inteſtine here, would, in our erect Poſture, have drawn the Stomach out of its due Situation, and might have twiſted or overſtretched the biliary and pancreatic Ducts ſo as to have ſtopped the Courſe of the Liquors in them; and therefore it is firmly tied down in its whole Courſe.

The Duodenum of Brutes is likewiſe placed in ſuch a Manner, as to anſwer the ſame uſeful Purpoſes.

Apes, whoſe Poſture is, for the moſt Part, erect, or nearly ſo, have theſe Parts diſpoſed in nearly the ſame Manner that Man has.

In Dogs, Cats, Cows, Sheep, and moſt other Quadrupeds, whoſe Poſture is horizontal, the Pylorus and Beginning of the Duodenum, are firmly connected to the Liver; after which a conſiderable Piece of Gut, with a Meſentery, hangs pendulous, and then the Inteſtine is faſtened to the Loins and Back-Bone: Therefore the pendulous Part muſt be loweſt in them. The biliary Duct opens into the Duodenum, where it is tied to the Liver; the Pancreas is long, and lodged in the Meſentery along the pendulous Gut, and its Duct is near the Middle of that Gland.

Hens, Ducks, Geeſe, and other Fowls, whoſe Poſture of Body is neither erect nor horizontal, but oblique, have the Beginning of the firſt ſmall

Inteſtine well ſecured to the Liver, from which the Inteſtine runs near to the Podex, and returns again, to near the ſame Place where it began, to be again tied to the Liver, all between theſe two Connections being pendulous. The Pancreas is fixed between theſe pendulous Parts, and its Ducts open into that Part of the Inteſtine where it had returned back to the Liver, as the biliary Ducts alſo do, but with a Direction oppoſite to the Courſe of the Aliment in the Inteſtine; after the Entry of theſe Ducts, the Inteſtine runs a good way along the concave Part of the Liver towards the membranous Diaphragm, being fixed to the Liver and to the Air * Membrane which lines the Abdomen: At length the Inteſtine makes a Curve to the right Side, and takes its Courſe towards the Podex.

In Cod, Haddocks, and ſuch Fiſh, the Cæcula, which are eſteemed analogous to the Pancreas of other Animals, ſurround the firſt Inteſtine ſoon after it comes from the Stomach, and then the Inteſtine is faſtened to the Liver, where the biliary Duct opens into it.

If then we conſider what Quantities of different Subſtances enter the Duodenum, we need not be ſurpriſed that this Inteſtine ſhould be more ſubject to Maladies than any of the reſt; eſpecially ſince it has not ſuch a firm Covering as the other Inteſtines have: And if the Inteſtine itſelf ſuffers, how ſoon muſt it diſturb many other Functions of the Animal Oeconomy, by the Preſſure it may make, when over-ſtretched, upon ſo many large Veſſels, Nerves, and other Organs, to which it is inſeparably contiguous; or by communicating its Afflictions to thoſe Parts which ſympathize with it, by means of the common Origin of their Nerves,

* I do not know what Dr. MONRO means by the Air Membrane; whether he means the cellular or that of the Peritonæum.

or

or by ſtopping the Influx of theſe two abſolutely neceſſary Liquors the Bile and pancreatic Juice.

In Diſeaſes of the epigaſtric or hypochondriac Regions, Care ſhould be taken not to confound ſuch as have their Seat in this Inteſtine with others, which require very different Treatment. This Caution is the more neceſſary, becauſe Authors generally take little or no Notice of the Duodenum as the Seat or Cauſe of any particular Diſeaſe.

Other Remarks on the INTESTINES, &c. by the ſame Author. Ibid. Vol. IV. Art. 12.

The Inteſtines are ſaid to be covered all over with a membranous Coat derived from the Peritonæum; but a conſiderable Part, a fourth at leaſt, of the human Inteſtines, is not covered with ſuch a Membrane. For the Meſentery being formed by the Peritonæum, produced on each Side, and including a conſiderable Quantity of cellular Subſtance, in which much Fat is frequently contained, together with the Glandulæ Vagæ, the meſeraic Arteries and Veins, the Nerves, Lacteals, and fat cellular Subſtance, being thick, till after the Membrane of each Side is continued ſome way upon the Inteſtine, all the Space between the Membranes, has no ſuch firm membranous Tunic covering it, and therefore more eaſily yields to any ſtretching Force, without over-ſtretching the Veſſels.

In this Space between the Inſertion of the Blood-Veſſels, the longitudinal Fibres of the Inteſtines can be ſeen diſtinctly and eaſily, becauſe the cellular Subſtance is ſeparated with little Trouble, or collapſes ſo much as not to hinder the View of the Fibres under it.

I need ſcarce obſerve that the circular Fibres of the Inteſtines are often ſo interlaced, that one can ſcarce trace the ſame muſcular Fibre round the whole Inteſtine.

It is generally known, that all the Subſtance between the interior Side of the circular muſcular Fibres of the Inteſtines and villous Coat, which uſed to be divided into the vaſcular, glandular, and nervous Tunics, can, by blowing into a Piece of Inteſtine, whoſe interior Side is turned exteriorly, be raiſed into a Tunica Cellularis, with numerous Veſſels running every-where through it, without any Fat in it; where, however, it appears there is ſome Secretion performed: For by injecting Water into the Arteries, theſe Cells are filled with it; and frequently, after making Injections of groſſer coloured Liquors, I ſee a Secretion performed, by the Cells being here and there diſtended with the white injected Subſtance, while the colouring Powder does not paſs with it. When this ſecreted Liquor hardens, it forms a Number of ſmall round or oblong Tubercles, which ſeveral imagine to be PEYER's Glands filled with the Injection; and this RUYSCH * ſeems likewiſe to think. I cannot yet bring myſelf to that Opinion, becauſe Water diffuſes itſelf ſo equally every where, and Injections which harden, do frequently the ſame for a large Space; at leaſt theſe make it evident, that if PEYER's Glands are ſometimes injected, there are alſo Veſſels which convey Liquors into this internal cellular Membrane; which may lead us into a reaſonable Account of the great Diſcharges of Mucus, after an Excoriation of the Guts, and of the hard Tubercles which are frequently ſeen within their muſcular Membranes, and of ſeveral other Phænomena of Diſeaſes.

* Epiſtol. 11. Reſponſ. & Sparſim.

In

In preparing a Piece of Inteſtine, in the Manner mentioned, for demonſtrating its internal cellular Tunic, we have a good View of the Tunica Villoſa in its membranous Form; when the Cellulæ are fully diſtended with Air, the villous Membrane loſes the downy, papillous, and mammillary Appearance which it has when the Inteſtine lies floating in Water.

Upon obſerving this villous Membrane when it is ſtretched, and how thin and flexible the Cuticula becomes upon the Lips, with the Continuation of the ſame Membrane in the Mouth, Tongue, Fauces, Oeſophagus, Stomach, and inteſtinal Canal; and, upon comparing the Properties which the external common Covering of the Body has with thoſe of this villous Membrane, they ſeem to be much of the ſame Kind, if not the ſame continued Subſtance.

The Cuticula is pervious to Liquors going out of the Body, and to others coming into it; ſo is the villous Membrane of the Inteſtines; and both of them have other Paſſages through them, whereby they allow certain Subſtances to penetrate to the Nerves, which they cover.

Thus a Numbneſs is brought on the Skin, by immerſing any Part of the Body in ſeveral Sorts of Liquors; and Pain is raiſed by Subſtances which do not deſtroy the Cuticle: Thus ſapid Subſtances affect our Tongue; and the different Senſations ariſe which we frequently feel from the Contents of the Stomach and Inteſtines.

The external Epidermis, by being expoſed to a Variety of different Forces acting on it, is of very different Thickneſs and Firmneſs, in ſeveral Parts; but it is naturally ſo flexible, as to allow a ſufficient Impreſſion of tangible Subſtances on the Nerves below it. The internal Membrane of the Inteſtines is leſs expoſed to a Variety of ſuch

Cauſes, and therefore is more uniform, but can be changed, in the ſame Manner, by like Cauſes.

And hence we frequently find the interior Surface of the Stomach and Inteſtines of a callous Hardneſs, and almoſt inſenſible; while, uſually, it is very ſenſible, and ſo flexible, that, being connected to the looſe cellular Subſtance, it hangs floating, and aſſumes any Shape the contractile Fibres of theſe Cells give it, whether of large Rugæ called Valves, or of ſmaller Papillæ of different Forms.

Thin watery ſaline Liquors waſh away the Cuticula, and thick mucilaginous Subſtances, protect it againſt them, and the bad Effects of Friction; therefore, wherever the Cuticula is expoſed to ſuch Injuries, its Defence is likewiſe provided.

Thus the Eye-lids are defended againſt the Tears; and their mutual Colliſion, by the ſebaceous Matter, ſeparated in their Glands; the Nipples, Armpits, Glans, Urethra, Perinæum, &c. are all protected in the ſame Way.

When their Defence is wanting, Excoriation, Pain, Inflammation, &c. follow; the internal Membrane of the Inteſtines, being more expoſed to the Action of watery Liquors, has a more plentiful Supply of the protecting Liquors, and is, in a ſound State, lined with Mucus.

A moderate Degree of Friction makes little or no Change on the Cuticula; but a violent one, gradually applied, makes the Cuticle become thicker, ſtronger, and firmer; as we ſee in the Soles of the Feet, and in the Hands of labouring People. Experience ſhews, that ſudden violent Friction either rubs the Cuticula imperceptibly off, or ſeparates it from the Skin. The villous Membrane of the Inteſtines is not expoſed to ſuch Accidents as the Surface of the Body, and is better defended, by Slime, from the bad Effects of Attrition,

trition, while the Abraſion of this Membrane may well paſs unobſerved: But the thickening and hardening of the Cuticula by Friction, may, however, be ſeen in the Inteſtines, when any hard concreted Subſtance is lodged a conſiderable Time in them; for then the internal Surface becomes there thick and hard.

The Epidermis ſeems to ſerve for contracting the Extremities of the cutaneous Veſſels, probably, by forming their Extremities: For whenever it is ſeparated, theſe Veſſels throw out their Liquors in much larger Quantities than ordinary.

If theſe Liquors were all thrown out of their Veſſels, between the Skin and Cuticula, and thence gradually eſcaped through the Interſtices of the cuticular Scales, there would perpetual Bliſters be raiſed in the depending Parts of the Body, if not all over the Surface of it; and the Liquor in Bliſters would eſcape through theſe Interſtices. The ſame Effuſion of Liquors is made into the Inteſtines, on the Separation of the villous Coat, in Diſeaſes where the Tongue and Throat ſhew the excoriated State of the alimentary Canal.

When any Part of the Cuticula is ſeparated from the Skin, but ſtill is continued with the adherent Scarf-ſkin, it becomes thicker, eſpecially if ſoaked with Liquors.

Thus the Cuticle of Bliſters, and what ſeparates from the Edges of Wounds and Ulcers, is frequently very thick: The ſame Thing happens in the alimentary Tube, as is evident in Aphthæ.

This Obſervation accounts for the tubular thick Subſtances voided at the Anus, which have been taken for Pieces of the Inteſtines.

The Epidermis is the moſt incorruptible, and leaſt ſubject to Eroſion, of any Part of the Body.

In Abſceſſes, the Pus has little other Effect on it than to ſeparate it from the Skin, and to tear it

by its Weight, but not to diſſolve it. In Gangrenes and Sphaceli it remains uncorrupted; after all that it covers is converted into a putrid Maſh; nay, it can allow the common Lapis Sapticus to penetrate through it, and diſſolve the Parts below, without ſuffering a Solution of its own Subſtance. This may be owing to its having no proper Veſſels or Liquors. The Tunica Villoſa enjoys the ſame Advantages in both.

Theſe Membranes, though indiſſolvable, are, however, ſeparable from the Parts they cover; the Conſequences of which are bad; therefore they are the moſt eaſily and quickly regenerated of any Organs in the Body which are not of the ſame Structure.

I never ſaw the Appendix Vermiformis, of any of the human Fœtuſes which I have diſſected, diſtended with Meconium; and therefore cannot allow it to ſerve as a Reſervoir of the Fæces during Geſtation.

From the numerous mucous Lacunæ in the human Appendix, and the like Structure in the Cæca of Brutes, its Uſe appears to be, to furniſh Mucus, to lubricate the internal Surface of the great Sac of the Colon, and to moiſten the Fæces in it, that they may be more eaſily puſhed forward out of this Part of the Inteſtine, where there is the greateſt Difficulty in their Progreſs, and where, by ſtagnating too long, they may bring on troubleſome Symptoms: Witneſs the Diſeaſe called Placenta Inteſtinalis.

The proportional leſſer Size of this little Inteſtine, in an Adult more than in a Fœtus, depends on the Preſſure it ſuffers, and being emptied ſo frequently of its Contents; whereas, in a Fœtus, there is no Reſpiration to ſqueeze it; and the Meconium in the Sac of the Colon prevents its being emptied: So that the Liquor ſeparated by its

its Glands being collected there, relaxes its Fibres, and diſtends it.

The Neglect of conſidering what the different Forces are which act upon the ſeveral Organs of the Body, while in a Fœtus State, and after Birth, has, in my Opinion, contributed to many Diſputes, which might have been put an End to by accounting for the Phænomena which were the Subject of them in this Way of Reaſoning. I ſhall mention one remarkable Difference in the Circulation of the Blood, and ſome few Conſequences from it.

Though the Heart and Arteries of Animals are able, by their Action, to keep up a Circulation in the larger Veſſels; yet, without Aſſiſtance from ſome other Powers, they cannot propel the Liquors with Velocity, and in ſufficient Quantity, through the ſmall Veſſels. Theſe aſſiſting Powers, after Birth, are the alternate Preſſure of Reſpiration, and the Action of the Muſcles. We can obſerve, at any Time, how much the Circulation is quickened by increaſing theſe; and, on the contrary, how much all the ſecerning Organs are diſtended and ſtretched by their almoſt ſtagnating Fluids, whenever one of them (to wit, muſcular Motion) is little exerciſed.

Thus Creatures turn fat, when they have no Exerciſe. Hence a Recruit of all the neceſſary Liquors in Time of Sleep; hence the ſtrong ſlow Pulſe of ſleeping People; hence the Deſire of continuing Sleep after a Perſon has ſlept beyond his ordinary Time; hence the ſmall Waſte of ſuch Creatures as continue long in a dormant Condition without any Supply of Food; hence a dry parched Mouth in the Morning, which is ſoon relieved by Chewing; hence Stilneſs and Lazineſs after abſtaining from Exerciſe too long; and a great many other Phænomena which will occur to any one, upon the leaſt Reflection.

Since

Since, then, the Heart and Arteries of Fœtuſes have little or no Aſſiſtance from any alternate Preſſure in propelling their Liquors, their ſecerning Organs muſt alſo be ſtuffed up, and diſtended; and therefore of a larger proportional Size than in the Adult. It is commonly ſaid, that the Thymus and Glandulæ Renales loſe more of their proportional Size in the Adult, than the other Organs. Admitting this as a Fact, though, on comparing them with the Brain, and ſome others, it is doubtful, it will not bring us under any Neceſſity of ſearching out ſome particular Uſe to which they ſerve in the Fœtus: For a View of their Circumſtances, as to Situation and Preſſure, will account for all the Differences obſervable in them. To underſtand this rightly, it may not be amiſs previouſly to conſider one or two Cauſes which may influence the Growth of animal Organs.

1. The Growth of the Parts of the Body will be greateſt where they are leaſt confined, and leaſt expoſed to preſſing Forces. The Brain is at firſt incloſed in Membranes, and is prodigiouſly large, in Proportion to the other Members; as the Bones of the Cranium become firm, its proportional Size diminiſhes; and after they are fully joined, its proportional Increaſe is very little: The Teſticles, on the contrary, are at firſt confined within the Abdomen, and ſmall; and afterwards, when they fall down into the Scrotum, they increaſe much faſter.

2. The greater the Force is, with which the Fluids are thrown into Parts, or the greater the Reſiſtance is to the Liquors, the more the Bulk of the Part will be increaſed. A Hand ſwells upon preſſing the Veins of the Arm; a Tumor in the Urethra, near the Caput Gallinaginis, occaſions a Swelling of the Teſticles.

To

To apply theſe Principles to the Thymus and Glandulæ Renales, we need only call to our Remembrance the Situation of one, in the double Mediaſtinum, between the Heart and its large Veſſels; and the Sternum, with the Lungs on each Side: The other lies on the muſcular Appendix of the Diaphragm, covered before by the chylopoietic Organs. Neither of them have any excretory Canal, except the lymphatic Veſſels are eſteemed ſuch; the Veins of both have a ſhort Courſe; and that of the Glandulæ Renales is remarkably large.

The greater Preſſure which the Thymus ſuffers after Birth, from the increaſed Action of the Heart and Lungs, is altogether evident; the immediate Play of the Diaphragm upon the other, ſhews as evidently, that there are ſcarce any glandular Parts in the Body; the Change upon which, as to Preſſure, is greater, after Birth, to what it was before, than in theſe two: And therefore, by our firſt Propoſition, they ſhould ſuffer in their Growth upon this Account.

But to this is to be added the Thinneſs of the Fluids ſent from them, and their ſhort Courſe in large Veſſels, which are almoſt peculiar to them; by which thin Veſſels muſt be leſs diſtended, and, conſequently, their Increaſe leſs, by the ſecond Propoſition.

Theſe Organs perform the Office of lymphatic Glands, both before and after Birth, and dilute the Chyle and thick Blood, which is ſoon after to be returned to the Heart.

☞ It is hoped, that the nice medical Reader will indulge our ingenious Author as to the Oddity of his Expreſſions; which, perhaps, are not ſo anatomical as one might expect from a Man of ſo great Repute.

LECTURE XI.

Of the KIDNEYS.

THE Renes, or Kidneys, are two pretty ſolid glandular Bodies, ſituated in the poſterior Part of the Cavity of the Abdomen, on each Side of the lumbal Vertebræ, between the laſt falſe Ribs and Oſſa Ilium. The right Kidney lies under the great Lobe of the Liver, and is, conſequently, lower than the left, which lies under the Spleen.

The Figure of the Kidneys reſembles that of a large Kidney Bean; their Circumference being convex on one Side, and concave on the other. The concave Side is turned to the Vertebræ, and the convex Side the oppoſite Way. Their Length anſwers to the Diſtance between the laſt falſe Rib and Os Ilium: They are about half as broad as long, and half as thick as broad.

In each Kidney we obſerve an anterior and poſterior Side; a ſuperior and inferior Extremity; a great and ſmall Curvature, and a Convexity and Concavity.

The poſterior is broader than the anterior Side, and the ſuperior Extremity is a little broader, and more incurvated, than the inferior. The Depreſſion in the ſmall Curvature is oblong and uneven, reſembling a Sinus, ſurrounded by ſeveral Tubercles; and as it is turned a little towards the anterior,

rior, this Side is somewhat narrower than the other.

The Kidneys are surrounded by a very loose membranous and cellular Covering called Membrana Adiposa, because in fat Persons the Cells of this Substance are filled with Fat. This was, for a long Time, taken for a Duplicature of the Peritonæum, the true membranous Lamina of which covers only the anterior Side of the Kidneys; and, consequently, they lie without the Peritonæum, because the Portion of that Membrane that covers them cannot be looked upon as an intire Tunic; so that the only common Tunic they have is the cellular Substance which likewise invests the renal Arteries and Veins in Form of a Vagina.

The proper Tunic or Membrane of the Kidneys is composed of two Laminæ, between which there is likewise a very fine cellular Substance, which may be made sensible by blowing through a Pipe between the two Laminæ.

The external Lamina is very thin, and adheres closely to the internal Lamina by means of the cellular Substance; the internal Lamina penetrates every where, by numerous Elongations, into the Substance of the Kidney, from which it cannot be separated without tearing.

The Surface of the external Lamina is very smooth, polished, and glistening; and it renders the whole Surface of the Kidney very even and uniform in Adults: In Children this convex Surface is, in a manner, divided into several Lobes or Tubercles, almost as in Oxen and Calves; and in grown Persons we sometimes observe the same Inequalities.

Sanguiferous Vessels of the Kidneys.

The descending Aorta and inferior Vena Cava lie between the Kidneys, pretty close to the Bodies of

of the Vertebræ, and to each other; the Artery being on the left Hand, the Vein on the right. Each of these large Vessels sends out transversly, towards each Side, commonly one capital Branch, which goes to the Kidney, and enters the Sinus, or Depression thereof, by several Rami.

These Vessels were by the Antients termed the emulgent Arteries and Veins; but I think the Name of Arteriæ Venæ Renales is much more proper. Sometimes there are more than one of each Kind, which is oftenest found in the Arteries, sometimes on one Side only, and sometimes in both.

The Artery and Vein are not of an equal Length; and the Difference depends on the Situation of the Aorta and Vena Cava: For the left renal Artery is shorter than the right, because the Aorta lies nearest the left Kidney; and the left renal Vein is longer than the right, because the Vena Cava lies fartheſt from the left Kidney.

These Vessels are likewise disposed in such a Manner, that the Veins lie more anteriorly than the Arteries, because the Aorta lies close to the Spina Dorsi; whereas the Vena Cava, which perforates the Diaphragm at some Distance from the Vertebræ, does not join them till after it has given Rami to the renal Veins.

Each renal Artery is surrounded by a nervous reticular Texture, called Plexus Renalis, which furnishes a great Number of Filaments to the Kidneys, which come partly from the semilunar Ganglions of the two great sympathetic Nerves, and partly from the Plexus Hepaticus and Splenicus. This renal Plexus sends likewise some Filaments round the renal Veins.

The sanguiferous Vessels, having entered the Kidneys, are ramified every Way; and these Ramifications send out other capillary Rami, which go all the Way to the Surface, where they appear like irregular

gular Stars, and furnish the proper Membrane of the Kidneys. Sometimes these two Ramifications penetrate to the Membrana Adiposa, and communicate there with the Arteriæ and Venæ Adiposæ.

The proper Membrane, having surrounded the Kidney all the Way to the Sinus, joins the Vessels at that Place, and accompanies all their Ramifications, thro' its Substance, in Form of a Vagina or Capsula; and likewise contributes, partly, to the Formation of the Pelvis and Infundibula.

We sometimes observe a considerable Vessel to ingress or exit from the convex Surface of the Kidney, but this is not common; and in that Case there is a Depression by which the proper Membrane enters, and communicates with that Portion which goes in by the Sinus.

The Tunica Adiposa, or common Membrane, which likewise invests the great Vessels to their Entry into the Kidneys, does not seem to accompany them any farther; but terminates at the Sinus, in the Interstices between the Ramifications.

Structure of the Kidneys.

We may distinguish three Kinds of Substances in the Kidneys: An exterior Substance, which is thick, granulated, and in a manner cortical; a middle Substance, which is medullary and radiated, called Striata, Sulcata, or Tubularis, because it seems to be formed of radiated Tubes; and an interior Substance, which is only a Continuation of the second, and terminates on the Inside by Papillæ; for which Reason I chuse to name it Papillaris.

These three Substances may be seen distinctly in a Kidney, by cutting it into two equal Parts thro' the great Curvature. The cortical Substance may be observed round the whole Circumference; and by the Microscope we perceive it to be of a spongy, gra-

granulated, and waving Texture; all its Parts adhering together in a radiated Manner. Its Colour is a bright whitiſh Grey *.

The other two Subſtances, that is, the medullary or ſtriated, and papillary, are really but one and the ſame Maſs, of a more reddiſh Colour, the convex Side of which riſes, at ſeveral Places, into narrow Tubercles, lodged in the ſame Number of Cavities or Depreſſions: The radiated Striæ are afterwards continued to the papillary Portion; and the Papillæ form, in ſome meaſure, ſo many Centers of theſe Radii, or Rays, oppoſite to the Tubercles.

The medullary Subſtance is likewiſe diſtinguiſhed from the cortical by the arterial and venal Curvatures, which ſend capillary Ramifications on all Sides; and its Colour is more or leſs red.

The Papillæ, which are only a Continuation of the medullary Subſtance, as has been ſaid, are often a little paler than that Subſtance. They are ten or twelve in Number, very diſtinct from each other, reſembling the ſame Number of Cones, with very broad Baſes, and obtuſe Apices †.

At the Point of each Papilla we ſee, even with the naked Eye, in a ſmall Depreſſion, ſeveral very ſmall Apertures, through which little Drops may be perceived to run, when the Papillæ are compreſſed: Theſe are little Drops of Urine, which being filtred, partly in the cortical, and partly in the medullary or tubular Subſtance, do afterwards

* By fine anatomical Injections, or in Inflammations, we diſcover an Infinity of ſmall capillary Veſſels, which run, in various Directions, between and round the different Portions of this Subſtance; and, by the Help of a Microſcope, we likewiſe ſee great Numbers of ſmall red Corpuſcles more or leſs round, and diſpoſed almoſt like Bunches of Currants. Theſe ſmall Corpuſcles are, perhaps, only the Extremities of the cut Veſſels, filled either with Blood, or a coloured Injection.

† Theſe are alſo named Tubuli Urinarii Bellini, from the Author who firſt deſcribed them; but their Number varies greatly in human Subjects.

paſs

paſs through the Subſtance of the Papillæ, and are diſcharged by theſe Orifices.

Each Papilla lies in a kind of membranous Calix or Infundibulum, which opens into a common Cavity called the Pelvis: This Pelvis is membranous, being of the ſame Structure with the Calices, of which it is a Continuation; and its Cavity in Man is not uniform, but diſtinguiſhed into three Portions, each of which contains a certain Number of Infundibula or Calices, together with the Papillæ which lie therein; and ſometimes we find two or three Papillæ in the ſame Infundibulum.

At the Place where theſe Infundibula ſurround the Baſes of the Papillæ, they ſend Productions into the medullary or radiated Subſtance of the Kidney, which accompany the Blood-Veſſels, and ſerve for Capſulæ or Vaginæ to all the vaſcular Curvatures, both arterial and venal, and to their different Ramifications, quite through the cortical Subſtance, and as far as the Surface of the Kidney.

After the Infundibula have contracted into a conical Form round the Apices of the Papillæ, each of them forms a ſmall ſhort Tube, which uniting at different Diſtances, along the Bottom of the Sinus of the Kidney, form three large Tubes which egreſs from the Sinus, in an oblique Direction, from above downwards, and immediately afterwards unite into one Trunk.

This Trunk becomes a very long Canal, called the Ureter. In Men, the three Tubes ſupply the Place of what is called the Pelvis in Brutes, and might more properly be called the Roots or Branches of the Ureters, than the Pelvis; which Name would agree beſt to the Trunk, as being larger than the reſt of the Ureter. The Ureters are commonly two in Number, one for each Kidney; but ſometimes there are more than two.

The Situation of the Trunk, and of the Roots and Branches of each Ureter, with reſpect to the renal Artery and Vein, is in the following Manner: The Artery is in the ſuperior Part of the Sinus, and partly before the Vein; the Vein is about the Middle, and between the Artery and Ureter; the Ureter is in the inferior Part, a little behind the Vein; and it is partly ſurrounded by one Branch of the Artery.

This Diſpoſition appears plainer near the anterior than near the poſterior Side of the Kidney, becauſe this laſt is broader than the former; and we likewiſe ſee there the three Branches of the Ureter, of which the ſuperior is the longeſt, and the inferior the ſhorteſt, becauſe of their oblique Direction inferiorly.

From this Deſcription we ſee, that, in the human Kidney, there is no other common or uniform Pelvis but the Trunk or Head of the Ureter, and the three great Branches. To have a true Idea of their Diſpoſition, we muſt imagine, that the Ureter enters the Kidney by the inferior Part of the oblong Sinus; that it increaſes gradually in Breadth as it advances, and is divided into three Branches, before it enters the Subſtance of the Kidney.

One of theſe Branches may be conſidered as a direct Continuation of the Ureter, and it is longer than the reſt; being extended from the inferior to the ſuperior Part of the Sinus; and it may be found without much Preparation: The other two Branches are ſhorter, and cannot be well diſcovered without an artificial Separation. The Angles between theſe Branches at their Baſes, or at the Head of the Ureter, are not pointed as thoſe of other Ramifications, but formed by a round Incurvation, which is generally ſurrounded by Fat.

Theſe firſt Branches of the Ureters produce other ſmall Branches at the Bottom of the Sinus, which

which are disposed in Pairs; these small collateral Branches extend in Breadth, and form the Infundibula or Calices, in which the Papillæ are lodged; the great Circumference of which produces, in the Substance of the Kidney, the different Vaginæ of the vascular Curvatures, and of their Ramifications. The internal Lamina of the Kidney is continued round these Vaginæ, and the external is expanded round the first Branches, Trunk, and all the rest of the Ureter.

If the Trunk of the Ureter be split on that Side which is next the Vertebræ, and this Section be continued to the Extremity of the superior Branch, we may observe, immediately above the Trunk, two Foramina lying near each other, which are the Orifices of the small collateral Branches, and Tubuli of the Infundibula: A little above these Foramina there are two others very much like them, and so on all the way to the Extremity of the superior Branch, which terminates likewise by these Tubuli of the Infundibula; and in each of these Tubuli we may observe, at least, the Apex of one Papilla*.

The Ureters run down obliquely, and with a very small Degree of Inflexion, from the Kidneys to the lateral Parts of the inner or anterior Side of the Os Sacrum, and, passing between the Rectum and Bladder, they terminate in the last of these Viscera in the Manner that shall be explained hereafter.

They are composed of three proper Tunics: The first of which, that surrounds the rest, is of a whitish Colour, and of a very compact filamentary

* A Section begun on the convex Surface of the Kidney, and carried from thence to the Trunk of the Ureter, discovers the Extent of the Papillæ very plainly, and likewise the Infundibula, their Tubuli, &c. but it will be difficult to give Beginners a just Idea of the Structure of these Parts, without the other Section.

Texture, being ſtretched with Difficulty, and appearing like a filamentary Subſtance degenerated; the next Tunic is of a reddiſh Colour, ſtronger than the firſt, and formed of different Strata of Fibres, which interſect each other; the interior Tunic is in ſome meaſure ligamentary, and lined with a very thin Membrane which covers a very delicate reticular Texture of Veſſels: It is ſlightly granulated like ſhorn Velvet, and moiſtened all over by a mucilaginous Liquor; it has ſeveral longitudinal Rugæ, which are interſected by a great Number of ſmall tranſverſe ones.

Beſides theſe proper Tunics, the Ureters are inveſted by the cellular Subſtance of the Peritonæum, the membranous Lamina of which covers likewiſe about two Thirds of their Circumference, ſometimes more, ſometimes leſs, but never ſurrounds them intirely; ſo that, when they are examined in their natural Situation, they appear like Ropes lying behind the Peritonæum, and jutting out, more or leſs, towards the Cavity of the Abdomen, together with that Portion of the Peritonæum which covers them.

All that has been ſaid about the Structure of the Ureters, Pelvis, Curvatures, Striæ, Foſſulæ, and Apertures at the Apex of the Papillæ, appears moſt diſtinctly, when theſe Parts are examined in clear Water.

Various Conjectures on the Secretion of the Urine.

The Kidneys are the Emunctories of the Body: There is no other Part that ſeems to receive the Urine. If we tie the emulgent Arteries, nothing is collected, either in the Ureters or Bladder. Some Anatomiſts, nevertheleſs, are of Opinion, that there are other Ways. The Ligature of the emulgent

emulgent Arteries does not ſeem to them to be a convincing Proof: Becauſe then the Convulſions and Diſorders which ariſe, ſhut the Strainers which are open when all is calm. Theſe are the Reaſons which make them doubt whether there are no other Canals diſcharged into the Bladder.

1. Mineral Waters paſs into the Bladder almoſt at the very Inſtant they are drank: The ſame Thing would happen to thoſe who drink much Wine. 2. The Water of dropſical People, contained in the Abdomen, is emptied, by Urine, in the ſame Manner as Abſceſſes of the Breaſt. 3. Clyſters are ſometimes voided thro' the Bladder, ſoon after they have been taken in.

Theſe Reaſons do not prove a Duct different from that of the Kidneys. 1. Mineral Waters, the ſame as Wine, do not immediately iſſue out from the Ureters; it requires ſome Time: Becauſe they muſt paſs through the lacteal Veſſels, thoracic Duct, ſubclavian Vein, Vena Cava, right Ventricle of the Heart, the Lungs, left Ventricle, Aorta, and the Emulgents. But when all that Space contains Mineral Waters, or Wine; then we may obſerve, that we cannot continue drinking without continually making Water; ſince, in Proportion as the Wine or Waters advance, a proportional Quantity of Urine is diſcharged.

2. The Water of dropſical People may re-enter the Veins by the abſorbent Tubes. Does not the Water, when we bathe, enter our Bodies? Are there not Abſceſſes in the Extremities, which are ſuddenly propelled? For this could not happen, if there were no abſorbent Tubes inſerted in the Veins: The Arteries could not receive them. For the Heart, which there continually propels the Blood, oppoſes the Entry of the Fluids.

It has been aſſerted, that the exterior Side permitted the Water to enter into the Cavity, and that the interior did not permit it to iſſue out. For this Reaſon, there have been Veſſels, covered over with Bladder, and the external Surface was placed externally. The Water, ſay they, which, when poured upon that Veſſel, penetrates the ſame, does not happen when the Membrane is applied to the Veſſel in ſuch a Manner that the external Surface anſwered to the Cavity. But this Experiment has not been ſucceſsful to all thoſe who have tried it. Beſides, Waters ſpread in the Abdomen are not emptied that Way: On the contrary, dropſical People make but very little Water.

3. Clyſters can enter the lacteal Veſſels which have been found in the Colon: They can even paſs into the ſmall Inteſtines, provided the Cæcum be not inflated; for the Entrance is not cloſely ſhut up but when the Cæcum is extended. After Clyſters have paſſed through the Lacteals, they will be carried to the Kidneys in the common Way: It may even happen, that they will not receive any great Change. We ſee that the Chyle has not been intirely changed in five Hours after a Meal.

Notwithſtanding all theſe Reaſons, there may be ſome private Paſſage which leads to the Bladder.

The ingenious Winslow has diſcovered a Saccus that reaches along the Spine, and terminates under the Stomach. Could not this Sac ſerve to carry the Urine through ſome Paſſage? Having ſeen that the Kidneys are the only Places where the Urine is ſecreted; let us ſee how it is filtrated.

The Blood propelled in the emulgent Arteries dilates the Ramifications which are ſpread all over the Subſtance of the Kidneys: Theſe Ramifications, dilated, compreſs the Blood which is contained in them, and propels it towards the Tube which they ſend to the Papillæ; but as theſe Canals

nals are narrower than the Extremities of the sanguinary Arteries, they will not be able to receive the red Part, nor the thick Lymph: But, 1. The aqueous Part will enter: For if we inject the emulgent Arteries with warm Water, the Water passes into the Veins, Lymphatics, and Ureters. MALPIGHI had no Success in this Experiment: But the Reason is, because he did not try it in a fresh Subject. The Air passes in the same Manner in these Tubes, as NUCK has asserted.

2. The oleaginous Particles attenuated, will make their Exit through these Tubes, and, consequently, will become a Fluid of a yellow Colour: For the Heat, which attenuated the Oil, gives it, at the same Time, a yellowish Tincture.

3. As the secretory Tubes of the Kidneys are larger than those of the other Strainers, the terrestrial and saline Particles can pass there: It is also this which we see by the Sediment found at the Bottom of Urinals. By this it appears, if, to explain the Secretion of the Urine, we must have Recourse to Ferments, Precipitations, or the Opinions of an infinite Number of Authors, who have abandoned an easy Mechanism for Ideas which have no Experiment to confirm them.

The Blood is continually propelled, in great Quantities, to the Kidneys, before they are freed of those aqueous and oleaginous Particles in the secretory Ducts: It is necessary, therefore, that the Urine be, in great Plenty, secreted in the Kidneys. The Blood, which flows to the inferior Parts, is deprived of its aqueous Part, and of a subtil Oil; that which enters the cutaneous Arteries, leaves, in the secretory Ducts of the Skin, the Matter of the Sweat and Transpiration. It follows hence, that, after reiterated Circulations, there is less Water carried towards the Kidneys; and thus the oleaginous Particles, which will be there deposited, will

be leſs diluted, and grow yellower than the preceding; ſince its Parts will not be mixed with Water, which clears its Colour, and makes it fluid. Beſides, the Heat this Oil has acquired, through ſo many Circulations, will again give it a deeper yellow, and render the Salts more acrimonious. It is for this Reaſon, that, when we have faſted a long Time, the Urine becomes very yellow and acrimonious.

If the Blood was propelled impetuouſly into the renal Ducts by the Power of the Heart, or Arteries, it would force the Ducts, which before received nothing but an aqueous and oleaginous Matter attenuated, and, conſequently, we ſhould piſs Blood; and this happens in the Small Pox, to thoſe who have a Stone in tne Kidney, and thoſe who have the renal Ducts very open, or lax: But if it ſhould happen that the Arteries were very much inflated by the Blood, then would enſue a Suppreſſion of Urine; for the inflated Arteries would compreſs the ſecretory Ducts, and ſo, conſequently, would obſtruct the Paſſage for the Fluid there filtrated. In order to make Urine, there is a Neceſſity for a conſiderable Contraction of the Arteries: For whilſt they contract, the Veins and excretory Ducts can be filled; which is the Reaſon why Opium ſtops the Urine: But if the Blood, in ſwelling the Arteries, hinders the Secretion of the Urine, the Tubes can there produce another Hindrance, by contracting. Hence it is, that, in hyſteric Fits, the Urine is like Water; the Convulſions which contract the Nerves, contract likewiſe the urinary Strainers. The ſame Thing happens in inflammatory Diſeaſes, and Suppreſſions which ariſe from the Obſtruction of the Kidneys. Theſe Symptoms will go off by relaxing or diluting Medicines, or Bathing; which always augment the Secretion of the Urine.

If

If it happens that Blood flows in the Kidneys which is too thick, or that many terreſtrial Particles are preſſed againſt each other in the Mamillæ, or Papillæ; it appears, that Concretions may be formed in the Tubes which filtrate the Urine; it is ſufficient that there is a Matter ſtopped there, that the oily Subſtance may ſtick there by Strata. For ſuppoſing grumous Blood or terreſtrial Particles in the Mamillæ; the Oil, which is viſcous, would obſtruct thoſe Concretions; the enſuing Heat would cauſe the Fluid to evaporate; or the Pulſation of the Arteries, and Preſſure of the Muſcles of the Abdomen, would preſs it out. Thus the dried Matter would form a Maſs of thoſe Bodies it met with.

This is what happens in the Filtration of the Urine. In ſhort, when it is diſtilled, by Drops, from the Mamillæ, by the Preſſure of the Heart, Arteries, Elaſticity of the Fibres, Muſcles of the Abdomen, and Reſpiration; it is received by Calices, which are Branches of the Extremities of the Ureters; and, either by its Weight, or the Urine which follows, or, laſtly, by the Preſſures before mentioned; it runs into the Ureters*.

The Blood of the renal Artery being leſs fluid than that of the Brain, and, probably, ſtored with more Water, brought by the ſerpentine Circles of the Arteries, depoſits the aqueous Portions into thoſe rectilineal Tubes of the Papillæ; a great Part of which Water contains Oil and Salts, intermixed with terreſtrial Particles, or ſuch Bodies as are ſmall enough to paſs through with it. But the ſmall Diameter of each Uriniferous Duct itſelf, at its Origin, and its firm Reſiſtance, ſeem to exclude the Milk or Chyle, and the thick or oleaginous and lymphatic Particles of the Blood, which are capable of hardening by Heat. Hence, therefore, it

* See Phyſical Eſſays on the Animal Oeconomy.

is,

is, that the Blood paſſes ſo eaſily through the open Uriniferous Tubes, whenever it is urged with an increaſed Celerity; or that by a morbid Relaxation they tranſmit not only oleaginous Particles of the Blood, but even Milk and nutritious Subſtances themſelves. The Urine, by Fire, or Putrefaction, ſoon changes into a volatile alcaline Nature, intermixed with a fœtid Oil, partly empyreumatic, yellow, and volatile; and partly very tenacious; to be ſeparated only by the laſt Degrees of Fire, under the Denomination of Phoſphorus: And, laſtly, it abounds more with Earth than any other Fluid of the Animal.

But there is alſo a conſiderable Portion of Sea Salt reſiding in freſh Urine, from which it is even ſeparable, after a long Putrefaction, in the making of Phoſphorus; in which Proceſs a very great Portion of the Urine is changed into a volatile Alcali. Nor is the Urine wholly deſtitute of volatile Acid, or at leaſt one much akin to it, both in that of Man and Brutes: But there is alſo a Sort of fuſible neutro-alcaleſcent Salt ſeparable in the Urine, and eaſily diſſolvable by Heat. In Fevers, the oleaginous and ſaline Particles of the Urine are greatly augmented, together with an Acrimony; as we know, by its increaſed Weight, Colour, and Tenacity. HALLER's Prim. Lin. Phyſ.

GLANDULÆ RENALES, or CAPSULÆ ATRABILARIÆ.

Immediately above each Kidney lies a glandular Body, called, by the Antients, Capſulæ Atrabilariæ; by others, Capſulæ Renales, Renes Succenturiati, and Glandulæ Renales: And they might be properly enough termed Glandulæ Supra-Renales*. They are ſituated on the ſuperior Ex-

* Firſt deſcribed by EUSTACHIUS, in Lib. de Renibus.

tremity

tremity of each Kidney a little obliquely, that is, more towards the interior Margin and Sinus of the Kidney than towards the external convex Margin.

Each Gland is an oblong Body with three Sides, three Margins or Edges, and two Points, like an irregular Crescent with its great or convex Edge sharp, and the small concave Edge broad. Its Length is about two Thirds of the greatest Breadth of the Kidney, and the Breadth of its middle Portion is about one Third of its Extent between the two Extremities, sometimes more, sometimes less. Its Colour is a dark Yellow.

It has an anterior, a posterior, and an inferior Side, which last may be termed the Basis; and it has one superior and two inferior Edges, one of which is anterior, the other posterior. The superior Edge may be called Crista, and the two inferior Edges, Labia. One of its Extremities is internal, or turned towards the Sinus of the Kidney; the other is external, or turned towards the gibbous Part of the Kidney. The Figure of this glandular Body may likewise be compared to that of a single Cock's Comb.

Structure of the Renal Glands.

The Surface of these Glands is uneven: The anterior Surface is the broadest, and the inferior Side, or Basis, the narrowest. Along the Middle of the anterior Side, a Ridge runs from the Edge of the interior Extremity, a little above the Basis, to the Point of the other Extremity, and divides this Side into two equal Parts, like the middle Rib of the Leaf of a Tree; and on the inferior Side, under the Basis, there is a kind of Raphe, or Suture.

The sanguiferous Vessels of these Glands come from the Arteriæ, Venæ Renales, Diaphragmaticæ, and likewise from the Aorta, Vena Cava,

Arteria Cæliaca, &c. These Vessels are termed the capsular Arteries and Veins; and, as they enter the Glands, they seem to be invested by a Vagina. They are not always derived from the same Sources, nor is their Number the same in all Subjects; and there is commonly a pretty large Vein, which runs along the Ridge. The Nerves, on each Side, are furnished by the adjacent semilunar Ganglion, and the renal Plexus which depends on it.

In the Inside of these Capsulæ there is a narrow triangular Cavity, the Surface of which is full of short strong Villi, of a yellowish Colour; but in Children it is reddish, and of a dark brown in aged People. The Sides of this Cavity are connected by a great Number of Filaments; and they appear to be wholly glandular, that is, to be filled with very fine small folliculous Corpuscles. Along the Top of the Gland these Sides touch each other immediately.

On opening this Cavity, we find a granulated or follicular Substance, which almost intirely fills it; and the sanguiferous Vessels are distributed on this, as well as on the Sides of the Cavity. If the Section be begun at the great Extremity of the Capsula, and continued through the superior Margin; and if the lateral Portions be afterwards separated, the glandular Body appears like a kind of Crista, raised from the Middle of the Bottom of the Cavity.

This glandular Body, or Nucleus, adheres more closely to the Bottom or Basis of the Cavity, than to the two Sides, especially near the great Extremity; but yet it may be separated, both from the Basis and Sides, being connected to them by a great Number of small Filaments. It adheres least to the Basis, near the small Extremity.

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The capsular Vein, which usually comes from the Vena Renalis, is much larger than the Arteries; and it communicates with the Inside of the Capsula much in the same Manner as the Vena Splenica with the Cells of the Spleen: For it may be inflated by blowing into any Part of the capsular Cavity; and the Air likewise passes into the Vena Renalis, &c.

This Cavity contains an unctuous viscid Liquor of a yellowish red Colour, which with Age changes gradually into a yellowish Purple, a dark, or a black Yellow; and sometimes it is perfectly black: But, even then, if it be spread thin on a large Surface, it appears yellow. It has sometimes been found not only reddish, but mixed with real Blood.

The Uses of these renal Glands have not, as yet, been discovered: And all that we know about the Liquor contained in them is, that it resembles the Bile. They are very large in a Fœtus, and diminish in Adults. These two Phænomena deserve our Attention to inquire about them.

They lie sometimes directly on the Top of the Kidneys; but I never found them on the gibbous Part. The Gland on the right Side is partly connected to the Diaphragm under and very near the Adhesion of the great Lobe of the Liver to that Muscle; that on the left Side adheres to the Diaphragm below the Spleen; and both these Connections are confined to the contiguous Portions of the inferior Muscle of the Diaphragm. They are involved, together with the Kidneys, in the Membrana Adiposa, a very thin Portion of which insinuates itself between the Kidneys and Glands, and also between them and the Diaphragm; so that they adhere to both by the Intervention of the cellular Substance, which in some Subjects contains a Stratum of Fat.

The

The venal Ridge, already mentioned, ſinks ſo deep into the anterior Side, in ſome Subjects, that the ſuperior Part of this Side appears to be ſeparated from the inferior: But this is ſeen moſt diſtinctly when the Capſula is examined in clear Water.

When the capſular Vein is opened lengthways with the Point of a Lancet, we diſcover in it a great many ſmall Apertures, many of which are only the Orifices of the Rami of the Vein; others are ſimple Apertures; and it is, perhaps, through theſe that the Air paſſes into the Gland, as already mentioned.

On the external Surface of theſe Capſulæ we obſerve a very thin diſtinct Membrane, ſeparate from the cellular Subſtance which ſurrounds them. Sometimes this Membrane is raiſed by an uneven Stratum of Fat, which makes it appear granulated; and, for the ſame Reaſon, the Capſulæ are of a pale Colour, like a Corpus Adipoſum.

The Liquor contained in them appears ſometimes in a Fœtus, and young Children, of a bluiſh Colour inclined to red.

To be able to diſcover the Uſes of theſe Capſulæ, we muſt not only attend to the two Circumſtances already mentioned, but alſo to their external Conformation, which is commonly more regular in a Fœtus and Children, than in Adults and old People. We muſt likewiſe conſider the Conſiſtence and Solidity of their Subſtance, which is greater before Birth, and in Childhood, than in an advanced or old Age; in which they are often very flaccid, and very much decayed: And this perhaps may be the Reaſon why the Figures given of theſe Glands taken out of their Membrana Adipoſa, are ſo very irregular.

VA-

Various Conjectures concerning the Uses of the Capsulæ Atrabiliariæ, or Renal Glands.

The Uſes of the Capſulæ Atrabiliariæ are, as yet, unknown: Their Structure affords us no Knowledge of them. Malpighi aſſerts, that if we cut them lengthways, they appear to be compoſed of long Tubes; theſe Tubes ariſe from the Circumference, and take their Origin from certain Follicules which ſuſtain the Veſſels and Nerves which there form a Rete: They advance towards the Middle, and meet in a Sinus covered by a Membrane which has many Apertures; from this Sinus there are Canals which are diſcharged into the Veins. Vanden Euryce has obſerved lymphatic Veſſels which enter there, and others which egreſs, in order to go to the Reſervoir of the Chyle. Riolan believed, that the Capſulæ had no other Uſe than to ſtrengthen the Plexus Reticularis formed by the coſtal and ſtomachic Nerve. Highmore will have them to be of no Uſe but in a Fœtus. Veslingius, with the Antients, thought that they were the Source of the Succus Atrabilarius, which, according to his Opinion, ſeparates the Serum from the Blood. According to Sylvius's and Kerkering's Opinion, this Juice cauſes an Efferveſcence in the Blood of the Heart. Petrucci was of Opinion, that it ſtimulates the Bladder, and, by this means, cauſes the Secretion of the Urine. Thomas Bartholine affirms, that their Uſe is to colour the Urine.

Molinet advanced an Opinion which appears, at firſt, more probable than all we have already mentioned. He believes, that the Fœtus makes little or no Water: It is not neceſſary, according to his Opinion; ſince the Blood of the Mother is de-

depurated. But, in order that no Secretion can be made in the Kidneys, the Courſe of the Blood muſt have been diſturbed, and a Receptacle muſt have been given it, before it arrived at the Kidney the Capſulæ from that Receptacle: Therefore it is that they are as big as the Kidneys in a Fœtus. This Opinion has its Difficulties. 1. It is certain, that the Capſulæ Atrabilariæ muſt not be looked upon as a ſimple Receptacle: There had been no Occaſion for their wonderful Structure on this Account. 2. It is certain, that there is ſome Secretion performed in them. We found a Fluid of a yellowiſh Colour, which returns into the Veins. Beſides, had not this Fluid been found, its Structure, reſembling that of a Viſcera deſtined for Secretion, would induce us to judge that there is ſome Matter there ſecreted. 3. This Opinion ſuppoſes that the Fœtus makes no Water: But this cannot be affirmed, till after BIDLOO's Opinion has been diſproved. HORNIUS and GRAEF have made the ſame Obſervation. 4. We cannot conceive how much ſmall Arteries could intercept ſo great a Quantity of Blood. BERGERUS makes this Objection. As for the other Proof which he brings againſt MOLINET, concerning the Defect of the Anaſtamoſes betwixt the Veſſels of the Mother and the Fœtus, we ſhall ſpeak of them hereafter.

The Lymphatics which enter and paſs through the Capſulæ gave Riſe to Opinions of their ſerving as ſecretory Ducts to the Lymph: In all this there is nothing, as yet, demonſtrated. In order to find out the Uſe of the Capſulæ, it muſt be looked after in a Fœtus: They are very large, as the other Organs which have no Uſe in Adults. All the Opinions, contrary to this, will be doubt-

* This Author was thought to have found out the Tunica Allantoïdes in the human Fœtus.

ful.

ful. We may, by that, judge of BOERHAAVE's Opinion, who believes, that these glandular Bodies are formed to return the Blood (which comes from the Kidneys) the Lymph which it has lost.

Dr. LIEUTAUD is of Opinion, that the renal Glands secrete a certain acrimonious Blood, which, when diffused into the Vena Cava, may stimulate and acceletate the Circulation, as we know the Blood moves but very slowly in that Vein. See Essay Anatomique, Art. XVII. p. 326.

OBSERVATIONS OF LUSUS NATURÆ.

In the Kidneys we often meet with Concretions of terrestrial Particles, sometimes petrified to a large Bulk, and at other Times so as not to be able to pass along the Ureters; which has occasioned some Practitioners to perform Nephrotomy, as they say.

These Organs vary prodigiously, with respect to their Magnitude: Sometimes they both connect; as we read in THOMAS BARTHOLINE's Anatomical History, Cent. II. concerning those of a Woman; likewise in CASPAR BAUHINE's Anatomical Theatre, who found the left Kidney in the Pelvis of a Boy, of four Days old, lying immediately below the left hypogastric Artery.

CASPAR BAUHINE makes mention of a young Girl, born of nephritic Parents, who, labouring long under a Suppression of Urine, a Swelling arose, about the Loins, which, having long waited for Suppuration to no Purpose, and finding only an Induration on the Part; a Surgeon boldly cut through the same, and drew out two Stones; after which, her Water came right, as formerly, the Wound being healed up. This History, says he, I had from my Master GULIELMUS CAPELLUS, when I was at Paris. Unde liquet (inquit ille) veram esse, HIPP. Sententiam quæ habetur. Lib.

de Morb. intern. calculos nimirum, à lateribus extrahi posse.

But I believe few Surgeons in our Days would attempt such an Operation.

We likewise meet with Kidneys full of purulent Matter. An Instance of this I met with some Time ago, in dissecting a Man who died of an acute Disease, after some Diseases, called Tabes Renalis, or Consumption of the Kidneys; they have been found intirely consumed, so as to be no more than a Capsula.

In HALLER's Disputation. Anatomicar. Select. Vol. III. we read, and see the Representation of the Ureters dilated to above an Inch Diameter near the renal Pelvis, and coming less gradually towards the urinal Bladder.

BARTHOLINE relates to have found the Ureters dilated to the Largeness of an Intestine.

The celebrated MALPIGHI, first Physician to Pope INNOCENT XII. who died of an Apoplexy November 29, 1694. On opening his Body, his right Kidney was found half as big as the left; and the Pelvis of the same Kidney three Times larger than it commonly is; which facilitated his voiding many small Stones, which he was afflicted with in his Life-time.

On opening the Body of Mr. COLBERT, Minister of State to Lewis XIV. King of France, many Stones were found in the Ureters.

STEPHEN BLANCHARD, in his XLVth Observation, says, that he found, in a Woman, both the Kidneys so hard and solid, as to resemble Alabaster. The same Author mentions to have found the Kidneys and renal Pelvis full of purulent Matter, in some Bodies, in others full of Stones; and one, in particular, which weighed two Ounces. Vid. Cent. I. Obs. LXXIX.

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A DIABETES, from an ill Diſpoſition of the KIDNEYS.

A Man, in the Flower of his Age, being a long Time afflicted with excruciating nephritic Pains, at laſt his Kidneys ulcerated, and brought upon him a Diabetes. He made no Difficulty in drinking Half a Hogſhead of Ale in a Week. After the Death of this Patient, his Relations gave me an Opportunity of opening the Body; in which I found the Viſcera very well diſpoſed, except the Kidneys and Ureters: For both the Kidneys were partly conſumed, eſpecially the right, the Subſtance of which was plainly diſſolved, and intirely conſumed, leaving only its Membranes greatly incraſſated and contracted to the Capacity of the Pelvis: The Ureters were alſo very much diſtorted, and in many Places dilated, or expanded, more than in others. RUYSCH's Chirurg. Obſ. XIII.

A fatal ISCHURIA, from Stones lodged in the URETER.

How deplorable a Malady of the Stone in the Bladder is, is ſufficiently known; but much more cruel is that in the Kidneys, when it is of ſuch a Magnitude as not poſſible to paſs through the Ureter: Becauſe, in this laſt Caſe, the Patient can receive no Relief, either from the Skill of the Phyſician, or Hand of a Surgeon. Of this we had an Inſtance of a certain Surgeon at Amſterdam, in the Year 1682, who, being for a long Time afflicted with nephritic Complaints, diſcharged many ſmall Stones; but, at length, fell into a ſpurious Iſchuria, from which he was once relieved by the Uſe of a Semicupium; but being afterwards ſeized with moſt intenſe Pains of the

Abdomen and Legs, and vomiting black-coloured Matter, at laſt expired.

On opening the Body, I found two Stones in the right Kidney, and one in the left Ureter; which laſt was of the Bigneſs and Figure of an Olive, having its Surface incompaſſed with ſmall Calculi or Particles of Gravel, which intirely intercepted the Paſſage of the Urine into the Bladder.

The ſuperior Part of the Ureter above the Stone was very much dilated, by the frequent Paſſage of Calculi that Way; but below, the Ureter was of its natural Capacity, but more red than it ought to be, having ſuffered an Inflammation. The Kidney of the ſame Ureter was alſo of a monſtrous Bulk, and appeared filled; as did alſo the greateſt Part of the Ureter, with an aqueous Humour, the Motion of which the Patient frequently felt, as he told us, upon moving his Body. Idem, Obſ. XV.

The Variations of Nature, which we meet with in Diſſection, happens no-where more frequently than in the Veſſels of the Kidneys. With reſpect to the renal Arteries, which are called Emulgents, they are ſometimes found double, or triple, at their Origin from the Aorta; from whence, however, they generally ariſe ſingle: But before theſe renal Arteries enter the Kidneys, they are variouſly ramified; being ſplit into two, three, or more Branches. With reſpect to the Ureters and Pelvis, though we generally obſerve, that each Kidney is furniſhed with only one; yet I have ſometimes found the Pelvis and Ureter divided into two, or even three. This Pelvis I have frequently obſerved ſo much dilated by Stones and Obſtructions, that they have been capacious enough to receive the Kidney itſelf. Although, likewiſe, the Ureters are generally ſingle; yet, on the contrary, I publickly demonſtrated in

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a Body, a left Kidney furniſhed with two Ureters, one of which aroſe from the ſuperior Part, and the other from the inferior Part of the Kidney: And by freeing theſe Ureters from their Integuments, I found both of them united into one before their Inſertion into the Bladder; and likewiſe the ſame Thing has been obſerved by RIOLAN. Idem, Obſ. LXXIX.

An extraordinary Expanſion of the KIDNEYS and URETERS of Sheep.

That the urinary Bladder ſhould, by the continual Afflux of that excrementitious Humour, be ſometimes diſtended to an immenſe Bulk, is not at all ſurpriſing, ſince its membranous Subſtance, continually receiving the Urine which is there accumulated, may by that means be very much extended. But that the Kidneys themſelves ſhould be diſtended into ſuch an immenſe Bigneſs from the Obſtruction of the Urine from them, ſo as to make them reſemble urinary Bladders, ſurpaſſes all Expectation, and muſt excite the Admiration of every one. Mr. VOGELESANG, an ingenious Surgeon and Anatomiſt, brought me two Sheeps Kidneys to be diſſected, which were ſo much diſtended, and filled with an aqueous Humour, that each of them contained near two Pints. The Ureters were much inflected, and of ſo large a Capacity, that they would have readily admitted the Root of a very large Parſnep.

The external Surface of each diſtended Kidney had not loſt its natural glandular Subſtance; but the intermediate Space was compoſed of a Membrane. Internally the Tabuli of the Pelvis reſembled large Cells, of ſo great a Capacity as to admit a Walnut covered with its green Shell. I could eaſily preſs the Urine, contained in the Bladder, towards the Ureters and Kidneys; but

then, to preſs the Urine back again from the Kidneys towards the Bladder, required a conſiderable Force; and I found it paſs, in a very ſmall Quantity, through a little Aperture in the Middle of a membranous Cloſure which lay between the Bladder and Ureters. In ſhort, the forementioned Aperture was of ſuch a Nature, that it freely admitted the Urine to paſs from the Bladder towards the Kidneys; but, on the contrary, it was almoſt in vain to attempt a Preſſure of the Urine from the Kidneys towards the Bladder: Whence, no doubt, proceeded a Regurgitation of the Urine; and this, in Proceſs of Time, produced ſuch a wonderful Expanſion of the Kidneys and Ureters.

Diseases of the Kidneys.

An Inflammation of the Kidneys may be known from the burning, pungent, and intenſe Pain of the Part where the Kidneys are ſituated; from the acute continual Fever, and the ſmall Quantity of Urine, which is very red, and deep-coloured; or, in the Height of the Diſorder, aqueous; a Stupor of the Leg; a Pain of the Groin, Teſticles, Ileum, and vomiting of Bile, with continual Eructations.

Such Diſorders may be produced by the general Cauſes of inflammatory Applications to the Kidneys. For, 1. Whatever hinders the Extremities of the Arteries from tranſmitting their Fluids; a Wound, for inſtance, a Contuſion, an Abſceſs, a Tumor, a long continued Defluxion, a ſtrong Effort of the Body, or a ſmall Stone. 2. Whatever hinders the Conveyance of the Urine into the Pelvis, Ureters, and Bladder, ſuch as Cauſes ſimilar to thoſe already enumerated, applied to theſe Parts. 3. Such Cauſes as forcibly drive the thicker Parts of the Blood into the urinary Ducts. Violent Running, for inſtance, hard Riding, exceſſive Heat, an Effort of the Body, a Ple-

Plethora, acrid Diuretics, and Poiſons. And, 4. A long-continued ſpaſmodic Contraction of all thoſe Veſſels.

When theſe Veſſels are ſeized with a violent Inflammation, they are often ſo conſtricted, that no Urine can be diſcharged; or if a ſmall Quantity be evacuated, it is pellucid, thin, and aqueous, which is a very bad Symptom; and the Nerves cohering to theſe Veſſels, and lying contiguous, being often irritated, Pains and Convulſions are produced in the Stomach, Meſentery, Inteſtines, and Ureters. Hence ariſe Eructations, Nauſeas, Vomitings, Fluxes, Iliac Paſſions, Retention of Urine, Stupor and Immobility of the Legs, and a preternatural Heat of the Loins.

If the Cauſes of the Nephritis are ſo ſtrong and powerful, that the Diſorder can neither be removed by Reſolution, nor any other Method, but is protracted beyond the ſeventh Day, and an Abſceſs is to be dreaded, the Formation of which may be known from a Remiſſion of the Pain, which is ſucceeded by a Pulſation, a frequently returning Horror, a Weight and Stupor of the Part. That an Abſceſs is already formed, is obvious, from the former Signs having proceeded from the Pulſation, Heat, and Tenſion, in the Part; and from the purulent, fœtid, and apparently ſaline and putrified Urine. As ſoon as we are certain that the Abſceſs is formed, we are firſt to uſe powerfully maturating and emollient Medicines; then, when the Urine appears purulent, we muſt exhibit Diuretics; but if a ſmall Quantity of the inflammatory Matter remains coagulated in the minute Folliculi of the Urine, it forms a kind of Baſis, to which the fabulous Matter of the Urine gradually adhering, forms a Stone in the Kidneys, which is, by Degrees, augmented.

A Nephritis, alſo, ſometimes degenerates into a Gangrene, as is obvious, from the Violence of the Cauſe and Symptoms; the Want of Relief by Remedies, and the ſudden Remiſion of the Pain, without any apparent Cauſe, accompanied with a cold Sweat, a weak and intermitting Pulſe, a Hiccough, and either no Diſcharge of Urine at all, or an Evacuation of ſuch as is livid, black, full of fœtid Filaments, and rendered unſeemly by brown or black Caruncles, and a ſudden and conſiderable Loſs of Strength: In this Caſe, no Medicines are of any Service, either for the Relief or Recovery of the Patient.

From what has been ſaid, it is obvious that there are almoſt an infinite Number of Species of a Nephritis; that their different Cauſes are as numerous; that one of theſe Cauſes is the Stone; and that, at the ſame Time, all theſe different Species are to be cured almoſt in the ſame Manner. Hence we underſtand the Criſis of a Nephritis, and why this Diſorder ſo often happens in Fevers; hence, alſo, we are enabled to know and cure an Iſchury, ariſing from the Fault of the Kidneys or Ureters. Vid. BOERHAAVE's Aphoriſms, Sect. 993.

WOUNDS OF THE KIDNEY.

Although the Kidney is not particularly ſpecified in this Aphoriſm of the great HIPPOCRATES; yet have its Wounds been commonly reputed fatal, on acconnt of its Situation, the Blood-Veſſels appertaining to it, and its proper Function, or Office: Notwithſtanding all which, FALLOPIUS declares, that he had known the left Kidney wounded with a Dagger, and the ſame healed: GEMMA ſays, that ſome Parts thereof were cut away by a Poniard thruſt into a Woman's Loins. As alſo DODONÆUS in Schol. ad Cap. XXII. Obſerv. ſuarum Medic.

But

But the moſt remarkable Inſtances we have had of theſe Wounds, have been ſuch as have been artfully made for the Relief of nephritic Perſons, or thoſe afflicted with Stones in this Part: Among which, I think, none more ſo than that Relation of PAREY, in Book XXIV. Chap. XIX. ex Monſtrelati Chronicis, containing the Story of a Malefactor four Miles from Paris, condemned for Theft. The Phyſicians acquainting the King that many of the Citizens of Paris being miſerably afflicted with the Stone, particularly one of his Nobles there named; this Criminal alſo, as appeared, having long laboured under the ſame Diſeaſe, it was their Requeſt to his Majeſty, that a Nephrotomy might be performed, for inſpecting, more particularly, the Seat thereof, and making Experiment of the Operation for extracting the Stone; and that his Life might be granted, on that Condition, if he ſurvived the ſame. Accordingly, at the Command of the King, the Section was made; and the Parts being ſcrutinized, the Body was afterwards ſewed up, and the Priſoner, in a little Time, recovered; having his Life preſerved, with great Rewards for his Pains.

But I do not remember to have read of any Surgeon who has made an Attempt to practiſe it ſince.

In a Boy, who died of the Stone, I found a double Ureter, each Part being dilated to an Inch Diameter; the Pelvis in each Kidney to twice its natural Bigneſs, and the Tubuli Urinarii each as large as the Pelvis.

In a Man, who had never been cut for the Stone, I found the Ureters dilated, in ſome Places, to four Inches Circumference; and in others, but little dilated: And a Stone, which I found in the Bladder, was leſs than a Nutmeg; which muſt have fallen into

into ſeveral Pieces, or elſe both Ureters could not have been dilated.

From this, and other like Obſervations, I think it appears, that the great Size to which the Ureters are uſually extended, in People who are troubled with the Stone, is owing to ſmall Stones which ſtick at the Entrance into the Bladder, until the obſtructed Urine, which dilates the Ureters, can force them into the Bladder.

I have, in ſeveral Subjects, found one Kidney almoſt conſumed; and, once, a Man with but one Kidney: And I have ſeen Lymphatics, in a diſeaſed Teſticle, as large as a Crow-quill. CHESELDEN's Anatomy.

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LECTURE XII.

Of the URINARY BLADDER.

THE Bladder is a membranous and muſcular Subſtance, capable of Dilatation and Contraction, ſituated in the inferior Part of the Abdomen, immediately behind the Symphyſis of the Oſſa Pubis, and oppoſite to the Beginning of the Inteſtinum Rectum. The Figure of it is nearly that of a ſhort Oval. It is broader on the anterior and poſterior Sides than on the lateral Parts; rounder above than below, when empty, and broader below than above, when full.

It is divided into the Body, Cervix, and Fundus; and into an anterior, poſterior, and two lateral Parts. The ſuperior Part is termed the Fundus or Bottom, and the Cervix or Neck is a Portion of the inferior Part, which is contractile.

STRUCTURE OF THE BLADDER.

The Bladder is made up of ſeveral Membranes, almoſt like the Stomach. That Part of the external Membrane which covers the ſuperior, poſterior, and lateral Sides of the Bladder, is the true Lamina or Membrane of the Peritonæum; and the reſt of it is ſurrounded by a cellular Subſtance, by the Intervention of which, the Peritonæum is connected to the muſcular Membrane.

The proper Membranes are three in Number; one muſcular, one nervous, and one villous, which is

is the interior. The muſcular Membrane is compoſed of ſeveral Strata of fleſhy Fibres, the exterior of which are moſtly longitudinal; the next to theſe are more inclined towards each Hand, and the interior more and more oblique; and they become, at length, almoſt tranſverſe. All theſe Fibres interſect each other in various Directions, and are connected by a fine cellular Subſtance, which may be ſeparated by inflating it.

The nervous Membrane is nearly of the ſame Structure with the Tunica Nervoſa of the Stomach.

The internal Membrane is ſomewhat granulated and glandular; and a mucilaginous Serum is continually diſcharged through it, which moiſtens the interior Surface of the Bladder, and defends it againſt the Acrimony of the Urine. It appears ſometimes altogether uneven on the interior Side, being full of Eminences and irregular Rugæ when empty, and in its natural State of Contraction. Theſe Inequalities diſappear when the Bladder is full, or when it is artificially diſtended by Air, or by injecting any Liquid.

At the Top of the Bladder, above the Symphyſis of the Oſſa Pubis, we obſerve a Ligament which runs up between the Peritonæum and the Linea Alba of the Abdomen to the Navel, diminiſhing gradually in Thickneſs as it aſcends: This Ligament, which is of particular Uſe in the Fœtus, is, in Part, originally a Production of the internal Membrane of the Bladder, and is termed Urachus.

The Umbilical Arteries.

They become in Adults like ligamentary Elongations, which are the Extremities of the umbilical Arteries: Theſe Arteries come from the Hypogaſtrics, run up by the Sides of the Bladder, and remain concave, and filled with Blood, even

in

in Adults, as high as the Middle of the Bladder, through all which Space they likewiſe ſend off Ramifications: Afterwards they loſe their Cavity, and become ligamentary, as they aſcend. At the ſuperior Part of the Bladder they approach each other, and, joining the Urachus, form that Ligament, which may be termed the ſuperior Ligament of the Bladder. Theſe are of no Uſe in Adults; but their Uſes ſhall be explained in the Lecture on the Fœtus.

The external Fibres of the muſcular Membrane are more numerous than the internal, and the moſt longitudinal anterior Fibres form a kind of Incurvation round the Urachus at the Top of the Bladder, much like that of one of the fleſhy Portions which ſurround the ſuperior Orifice of the Stomach and inferior Extremity of the Oeſophagus. This Incurvation paſſes behind the Urachus.

The Portion of the Peritonæum which covers the poſterior convex Side of the Bladder, forms a very prominent tranſverſe Fold, when the Bladder is contracted, which diſappears when the Bladder is extended: This Fold ſurrounds the poſterior Half of the Bladder, and its two Extremities are elongated towards each Side; by which Elongations a kind of lateral Ligaments of the Subſtance of the Bladder is formed, which are more conſiderable in Children than in Adults.

The inferior Part of the Bladder, which deſerves the Name of Fundus much better than the ſuperior, is perforated by three Openings, one anterior, and two poſterior. The anterior Opening is formed by an Elongation of all the proper Membranes: This Elongation is called the Neck of the Bladder, and ſhall be deſcribed with the Parts of Generation in Men.

The other two Openings in the true Fundus of the Bladder are formed by the Ureters, which in their Courſe downwards, already deſcribed, run behind the ſpermatic Veſſels, and then behind the inferior Part of the Bladder, approaching each other. Each Ureter lies between the umbilical Artery and Vas Deferens of the ſame Side; the Artery lying on the external Side of the Ureter, and the Vas Deferens on the internal.

Afterwards they creep between the Vaſa Deferentia and the Bladder, croſſing theſe Canals; and then, at about a Finger's Breadth from each other, they begin to pierce the Membranes of the Bladder. They run a little way between the muſcular and nervous Membranes, and open into the Bladder obliquely, ſomewhat nearer each other than when they firſt entered its Membranes.

The Orifices of the Ureters in the Bladder are ſomewhat oval, and narrower than the Cavity of the Ureters immediately above them. The Edges of theſe Orifices are very thin, and ſeem to be formed merely by the Union of the internal Membrane of the Bladder with that of the Ureters.

The Bladder is ſupplied with ſanguiferous Veſſels from the Hypogaſtricæ or Iliacæ Internæ; being Rami of the Arteria Sciatica, Epigaſtrica, and Umbilicalis, on each Side.

The Nerves of the Bladder come from the Crurales, and alſo from the Sympathetici Maximi, by means of their Communication with the Crurales: It has likewiſe ſome Nerves from the Plexus Meſentericus Inferior.

Beſides the Ligaments already mentioned, there are likewiſe two ſmall ones, by which the anterior Part of the true Fundus of the Bladder is connected to the Oſſa Pubis, which ſhall be deſcribed with the Cervix and Sphincter.

Use of the Urinary Bladder.

As it was neceſſary, for the Welfare of the Body, that an excrementitious Fluid ſhould be ſecreted by the Kidneys from the Maſs of Blood, and thence diſcharged by the Ureters; therefore it was neceſſary that there ſhould be a Reſervoir to receive the Urine, and thereby allow the Animal proper Intervals for the Performance of other neceſſary Functions. For if there was no ſuch Reſervoir, but that the Ureters terminate in the Urethra, there would be a perpetual Dripping of the Urine, as the Secretion is performed, to the no ſmall Inconvenience of the Animal.

Birds and Fowls have no Bladder; but their Ureters are terminated by the Inteſtinum Rectum, and mixes with the Excrements.

This Reſervoir, or Receptacle, is a membranous Saculus of a flexible Nature, being capable of Dilatation and Contraction, according to the Neceſſity of retaining or expelling its Contents.

Its internal Membrane is of a delicate nervous Texture, and therefore capable of Irritation, and furniſhed with innumerable Glands, which ſecrete a Mucus to guard the Bladder from the too great Acrimony of the Urine: For when any Accident happens to theſe Glands, as by taking acrimonious abrading Medicines, or by a ſharp hectic Blood, which deſtroys this Mucus, it ſhould be laid bare, we ſhould be liable to ſuffer exquiſite Pain: And though it is thus guarded by the Mucus, yet its Senſation is not quite blunted; that Matter ſerving alſo as a Medium through which it is capable of being ſufficiently irritated without Pain, as the Cuticula is the Medium thro' which we feel (without Pain) any Subſtance we touch.

But if this Mucus ſhould, on the contrary, become too much condenſed (which is the Caſe in thoſe

thoſe who have a Lymph loaded with coagulated Salts), it would become hard, and, as it were, incruſted; which would obſtruct the Glands.

From ſuch an Obſtruction, therefore, might proceed an Induration of ſome of the Glands, which, when once begun, the gradual Increaſe of a ſchirrous Bladder is inevitable, from the conſtant Preſſure and Induration of other Glands by thoſe firſt obſtructed.

Over-long and great Exerciſes will cauſe this Drineſs of the Mucus of the Bladder: For thereby Perſpiration is ſo increaſed, that the more fluid Particles, which ſhould dilute that Matter in the ſecretory Glands of the Bladder, are thrown off through the Pores of the Cutis, and the Mucus left in a very viſcid State; whereby it is as capable of farther Coagulation and Induration, as the White of an Egg.

The Mucus may be alſo over-fluid, or the Tone of the Glands be too much relaxed; whereby great Quantities of that Matter will appear in the Urine of Perſons who imagine themſelves free from any Diſorder: And it may be, and, no doubt, is, often miſtaken for the purulent Matter of an Ulcer in ſome of the urinary Organs; or ſome Weakneſs in the proſtrate Gland, Veſiculæ Seminales, or the like: Whereby we might be deceived, and preſcribe what might increaſe the Diſorder.

Riverius calls it a depraved Diſpoſition of the Bladder; and teaches us how to diſtinguiſh it, ſo as to be certain from whence it comes. He ſays thus: That Matter coming away from the Bladder is different from that of any other Part in this, that it is more tenacious and glutinous, and will ſtick to the Sides of the Urinal after the Urine is poured off, and afterwards can ſcarce be ſeparated from the Veſſel: Whereas the Mucus from any other

other Part does not adhere to the Veſſel, but comes off with the Urine.

The interior or nervous Membrane is much larger, and more extenſive, than any of its Covering; and therefore, when they are contracted, this appears in the Plica, having no Elaſticity whereby to contract; and even after the external Integuments are much dilated, there will Rugæ ſtill appear in it.

This is of wonderful Uſe. For ſuppoſing that, by any Accident, the Urine was detained in the Bladder longer than ordinary, ſo that the external Membranes were upon the Stretch; it was highly neceſſary that the nervous Tunic, being ſo ſenſible of Pain, ſhould ſtill have ſome Plica to ſpare, that there might be more Time to promote the Diſcharge of Urine by proper Application. Becauſe, if this Membrane be extended as ſoon as the others, Convulſions would follow, inevitably, the Rugæ. Therefore from the Rugæ, we may alſo account for the Receptacles in which Stones are ſometimes found in the Bladder.

Where a tenacious Mucus abounds, and one or more Stones happen to be ſtuck between two Plicæ, they are glued to the Stone, and a ſlight Inflammation happens; which cauſes the Villi of that Membrane to ſhoot out, and extend themſelves over the Stone, whilſt the Mucus itſelf grows ſtill more tenacious, and has often the Appearance of a Membrane. This made TULPIUS ſay, that two Stones, voided by a Woman, had Membranes round them, which were nothing but Mucus condenſed and dried about them.

Thus may Stones acquire membranous Productions round them in the Bladder, and thereby become inſeparable from it; and when theſe Villi do not ſhoot out to cover them, yet they may have mucous Coverings which dry into a kind of Mem-

brane, either adhering to, or ſeparate from, the Bladder. When the Bladder is taken out of the Pelvis, and inflated, then the Rugæ of the internal Membrane diſappear: Becauſe, when the muſcular Membrane is thus diſtended ſo much as to obliterate the Plica in the nervous Tunic, it has no more Power to contract itſelf as before; and, conſequently, when the Air is let out, all the Membranes and Muſcles collapſe together. The ſame will be the Caſe in thoſe who, being ſubject to the Stone, and very frequent Obſtructions of Urine, have the Bladder often diſtended by Repletion; and its Elaſticity weakened by the long Uſe of irritating acrimonious Medicines: And there can be no greater Sign of Injuries having been done to the Bladder, than (upon taking it out of the Body without inflating) finding its whole Compages relaxed, and cutting into it, finding the Rugæ obliterated. See the ingenious Dr. PARSONS's Deſcription of the Urinary Bladder, &c.

OBSERVATIONS ON THE NATURE OF URINE.

Before we explain the Nature of Urine, we muſt look into the different Forms under which this Fluid makes its Exit. It varies, according to the Aliments we take, and according to the Paſſions and Times. When we drink much, it reſembles Water, is deprived of Taſte and Smell, and can eaſily be retained; but when we have eat, and the Chyle is ſeparated from the Aliments, it is coloured, leſſer in Quantity, and has ſome Smell. It is not then ſo eaſily retained, becauſe it irritates the Sides of the Bladder by its Acrimony. When the Chyle is changed into Blood, it is redder, and not in ſo great a Quantity: Its Acrimony augments and irritates more the Fibres of the Bladder. Laſtly, When, by Abſtinence, the Blood is not re-

renewed, the Fluids are heated in the Body, the Urine is not so clear as those we have spoken of, it alcalises sooner, and consequently is more acrimonious, more disposed to putrefy, and less in Quantity.

These are the Substances which the Urine is composed of: 1. There is a real Water. 2. An acrimonious Salt, very subtil and volatile, like an Alcali. 3. A very volatile Oil, which is disposed to putrefy. 4. A Caput Mortuum, which has been very much attenuated by these Substances, and the Motion of the Circulation.

The Water of Urine is insipid. We may be convinced of this in letting it evaporate: We observe no Smell nor Taste; yet there remains a very subtil Part of the fœtid Oil, which cannot be separated from it. This is the Reason why the Water rather deserves to be called Spirit, than Phlegm.

The Salt of the Urine is neither acid or alcali; it is an acrimonious ammoniacal Salt. If there is any fixed Salt found, it is Sea Salt, which is made Use of in Aliments, and changes not its Form except in the human Body, while the more fixed Salts are intirely changed. The Oil of the Urine is but a Portion of the Fat which has been subtilised: It is very different from all other Oils.

The Caput Mortuum is mixed in the Substances we were speaking of. When it is separated, it is insipid, fixed, and white.

The Mixture of these Substances compose different Sorts of Urine, according to their different Proportions: These are the Qualities with which it should be endowed when the Body is in a State of Health; the Colour must be that of a Citron: In those who have a Fever, it is reddish, or of a very deep Colour; in hypochondriacal People, and Women subject to the Vapours, it is white.

The Smell, according to TECMEYER, must be like that of Violets: But if it were so, we should but very seldom find natural Urine. BELLINI had more Reason to say, that it should have almost no Smell at all.

The Smell really cannot proceed but from the Salts which tend to be alcalised, and from the Oil's tending more to a Putrefaction. All this is contrary to the natural State of Fluids in the Body.

As for the Sound of Urine, when it falls into the Urinal, it must be like that of common Water.

In order to have a thorough Knowledge of all which concerns the Urine, we must examine from whence arises its Colour. When the Phlegm is evaporated, 1. It becomes yellower. 2. It appears redder. 3. Blackish. In changing from one Colour to another, it takes a deeper, and becomes always thicker, and more saltish: At last there remains a viscous Substance, which, in the Bottom of the Pot, seems to be of a pretty dark Colour; but if we rub the Surface of the Pot with it, it gives it a fine yellow Colour.

The Urine being thus evaporated, we may pour Water upon it. According to the Quantity of Water poured upon it, the Urine will have the same Colours we were just now speaking of: It will be the same as before its Evaporation; and will have the same Smell and Taste. It will putrefy, thicken, and precipitate to a Sort of Tartar.

According to this Experiment, the Urine is more or less coloured, or saltish, according to its greater or less Quantity of Phlegm; by which we shall be able to give an Account why the Urine is of a different Colour in different Ages, Climates, and Passions; and why the Urine of those who are of a hot Constitution is coloured. 1. Because there

there is a great Evaporation made of the aqueous Subſtance by Tranſpiration; therefore there muſt be leſs Phlegm in that which is filtrated by the Kidneys. As the Blood is more agitated in its Veſſels, the oleaginous Matter, being more divided, will paſs eaſier; the contrary of which happens in old People. By only applying theſe two Reaſons to other Cauſes which vary the Urine, it will appear, that in hot Climates, and violent Paſſions, as Anger, the Urine muſt be very much coloured.

There are three Things to be obſerved in the Urine. 1. A Sediment of Matter which is precipitated at the Bottom of the Veſſel. 2. A Subſtance which is ſuſpended in the Urine, and goes by the Name of Anæorama. 3. A Subſtance which is like a Cloud. The Sediment is nothing elſe but an earthy Subſtance mixed with the Salt of Urine: When there is a Motion in the Subſtance of the Urine, or, rather, whilſt the Heat rarefies the groſs Parts, theſe Matters are there ſuſpended; but when the Cold contracts them to a leſſer Bulk, they are precipitated. When theſe Subſtances have been very much rarefied, then they are ſuſtained in the Urine, and form what is in Latin called Suſpenſiones: The Clouds are nothing but the ſame Subſtances rarefied in ſuch a Manner that they occupy the ſuperior Part of the Urine. Theſe Principles ſuffice to make us judge of all the reſt.

We may have Room here to aſk three or four Queſtions. 1. Whether the Urine comes from the Blood? 2. Whether it is equal to, or above, the Quantity of the Liquor which we drink? 3. Whether we may judge of Maladies by Urine? In order to void, by the Subſtances which circulate with the Blood, they muſt paſs from the Inteſtines into the lacteal Veſſels, from thence into the Receptaculum Chyli, and at laſt into the Veins,

Heart, Kidneys, and Bladder. It is already demonſtrated, that there is no other Way: So that the Urine comes from the Blood.

By this means we may explain, 1. Why, when we have been agitated by violent Motions, we void Blood, though there is no Stone in the Kidneys. The Blood, being violently propelled, dilates the ſecretory Canals, and paſſes off with the Urine. 2. It appears alſo, by this, why Heat, Motion, Sweat, and Abſtinence, make the Urine red, acrimonious, ſaltiſh, and nauſeous: The Blood then loſes its aqueous Particles. The Heat which is produced by Motion diſengages the Salts, and attenuates the Oil: It muſt then depoſit a coloured Fluid in the Kidneys, more ſaltiſh and fœtid, than the Blood itſelf; becauſe in its Veſſels it is mixed with more viſcous Subſtances, and more heated, than in its Ducts.

Some Phyſicians were of Opinion, that the Urine is more in Quantity than the Liquor which we drink: But this is inconſiſtent. All the Aliments which we uſe are filled with Juices: Thus Urine may ſurpaſs, in Quantity, the Liquor we drink. Nevertheleſs, according to Tranſpiration, other Evacuations, and Diſeaſes, the Quantity of Urine diminiſhes or increaſes.

Some Quacks pretend to know Diſeaſes by the Inſpection of Urine only: But this is impoſſible. 1. In order to do this, it is neceſſary that every Diſeaſe, according to the Part affected, ſhould impreſs a particular Character on the Urine; which is impoſſible. 2. They muſt alſo know exactly the natural State of Urine in every Subject: Becauſe there are Perſons whoſe Urine is like that of ſick People when they even enjoy a perfect State of Health. 3. The Air alters Urine ſoon after it has been diſcharged from the Bladder. 4. The renal Tubes are ſometimes very much dilated; which

which make great Alterations in the Urine, tho' the Perſons are very well. 5. The State of the Blood cannot be known by Urine; becauſe the Heat, Age, Aliments, and Paſſions, change it, from Time to Time: We ſhall not be able to judge of the Diſtempers which attack the Solids by it; and yet, in malignant Fevers, the Pulſe and Urine will appear as good as in thoſe who enjoy a perfect State of Health.

The Urine forms Stones in the Bladder and Kidneys. They have Recourſe to divers Hypotheſes in order to explain this Phænomenon: Some have aſcribed it to a petrified Fluid; others to chymical Mixtures: There are others, alſo, who have aſſerted, that the Stone is formed in the ſame Manner as thoſe ſtony Incruſtations which are found in Veſſels where there has been Water a long while boiling, or in the ſame Manner as the Tartar which ſubſides in Hogſheads.

Fernel explained the Formation of the Stone beſt. He ſays, that there is no Stone formed in the Bladder unleſs there be a Kernel which ſerves for a Baſis. Round this there are Strata of a viſcous Subſtance. There is really obſerved in almoſt all Stones, a Subſtance in the Strata which contain it.

Nuck's Experiment, made by other Anatomiſts after him, confirms this Opinion. This Anatomiſt opened the Bladders of ſeveral Dogs. He there put a Sort of Subſtance like Cloth: Some Time after, having again opened the ſame Bladders, he found, that there was a real Stone formed round that Subſtance. This being laid down, if the Blood abounds with terreſtrial Matter, a Part of that Matter will remain in the Kidneys or Bladder. If the Bladder is lax, as in Infants; or inflexible, as in old People; this Matter will not be expelled: So that the Strata of a viſcous Matter will be

formed round it. As for the Sand which is in the Urine, it is nothing elſe but the terreſtrial Particles concreted and ſeparated from the Oil. I have ſometimes ſeen whitiſh Concretions which reſembled Mortar, and ſmelled very ſtrongly.

This is almoſt all that can be ſaid of the Urine, and the Strainers through which Nature has made it paſs.

The Animal Oeconomy cannot be deprived of this Secretion without Diſorder. It is true, the Tubuli, which ſecrete the Sweat, could ſupply it, in ſome meaſure; yet, when the Urine is cloſed in the ſanguinary Veſſels, it cauſes Convulſions, Lethargies, and Apoplexies. Sometimes the Urine, thus gathered, is diſſipated through the Pores which ſerve for Tranſpiration.

SALMUTH gives an Account of a Man's ſwelling all over his Body after a Stoppage of the Urine, cauſed by nephritic Pains. The Sweat diſſipated the Matter which cauſed the Swelling, and facilitated the Exit of the Stone. [See Phyſical Eſſays on the Parts of the human Body, and the animal Oeconomy.]

It does not ſeem that there is any other Way for the Urine to paſs to the Bladder than from the Kidneys and Ureters. Though we know that the Stomach, like other Membranes, exhales a Moiſture through its Tunics; and though it is not improbable, from Experiments, that the Bladder alſo abſorbs; and though the Paſſage of mineral Spaw Waters, by Urine, be extremely quick; yet it does not thence follow, that there muſt be Ways, different from that of the Ureters, to convey the aqueous Portion from Digeſtion to the Urinary Bladder.

As the Bladder is, on its whole Circumference, ſeparated from the abdominal Cavity by the Peritonæum; nor is it very likely that the Vapours, which

which either egreſs from the Bladder, or are derived towards it from other Parts, can here find open Pores through the Peritonæum; nor do Membranes imbibe much which has been macerated for any Time, ſo as to fill their Pores with Humours: And if we conſider attentively the Manner in which mineral Waters are diſcharged by Urine, it it demonſtrable, that there is no ſuch Rapidity therein as is commonly imagined: But the Stimulus of cold Water drank, does, like the external Cold applied to the Skin, cauſe a Concuſſion of the Bladder and urinary Parts, by which they are ſolicited to repeated Diſcharges of that Urine which was firſt in the Body, and not that which was immediately drank.

Moreover, the Largeneſs of the renal Veſſels demonſtrate, that not much leſs than an eighth Part of the Blood ſent to the Body is received at a Time; and, conſequently, there are above a Thouſand Ounces of Blood conveyed through the Kidneys in an Hour. Whence it will appear but a moderate Allowance for Twenty-five Ounces of Water ſecreted from ſo great a Quantity of Fluids. It is certain, that, both in Man, and other Animals, the Urine will putrefy, if the Ureters are obſtructed by any means: Therefore it can paſs into the Bladder. HALLER's Prim. Lin. Phyſiol.

OBSERVATIONS.

A Man of Fifty-five Years of Age, who was thought to be troubled with the Stone, could not retain above three or four Spoonfuls of Urine in his Bladder; which obliged him to make Water very often, and in the Evacuation he felt ſevere Pains. As the Patient complained of no other Symptom which could indicate that it was a Stone, I was doubtful whether it was that Diſtemper, or not; and preſumed, that his Bladder might have been

been contracted, or be in an inflammatory State, since he drank plentifully of Wine.

I probed him carefully, and found no Stone. I then ordered him to be let Blood four Times, prescribed him a regular Diet and emollient Ptisans, with Injections, &c.

For the Space of a Fortnight the Bladder, which at first was capable of containing only two Spoonfuls of Injection, resumed, by degrees, its natural Capacity; which I knew, by the Quantity of Injection admitted without causing Pain. LE DRAN's Obs. in Surg. LXXX.

An Excrescence or Tumor arising between the internal Tunics of the Bladder, is a Disease very uncommon; and hitherto no one has attempted the Cure of it by Extirpation: Nor, indeed, can it be supposed that the Instances are frequent, where the Operation is practicable.

A Woman, of Twenty-three Years of Age, on the Twenty-fourth Day of June, 1747, strained herself, by endeavouring to lift a great Weight. She was immediately seized with a Pain in the Small of her Back, and a total Suppression of Urine; which Symptoms, notwithstanding the various Methods used for her Relief, continued till the Twenty-ninth of the same Month; when an eminent Physician, and Man-midwife, was called to her Assistance; who drew off her Urine with a Catheter. In April, 1750, she applied to Mr. WARNER; whom (after proper Inquiry) she told, that, ever since the Accident, she could not void a Drop of Urine without the Assistance of a Catheter.

She was in continual Pain, and had lately been weakened by having, at several Times, lost considerable Quantities of Blood, occasioned by the introduced Catheter.

On

On examining her Meatus Urinarius, I discovered a considerable Tumor, which seemed to be of a fleshy Substance, and to take its Rise from the inferior Part of the Bladder near its Cervix; and it protruded a little way out of the urinary Passage, upon straining to make Water.

Seeing this, I dilated the Passage by Incision; when, by pulling the Tumor forwards, I had sufficient Room to tie it. On the sixth Day after this Ligature was made, the Tumor dropped off. It was nearly equal to a Turkey's Egg, both in Bulk and Shape.

After the first Day of the Operation, she voided Urine without any Instrument, and is now perfectly well recovered. See Mr. Joseph Warner's Cases in Surgery.

Haller tells us of a Merchant who had all the Symptoms of the Stone in the Bladder, yet none could be felt by the Catheter; but, after his Death, two large Stones were found, each inclosed in a Membrane in the Bladder. Vid. De Morb. Intern. Scholiograph.

Martin Holtzapel gives an Account of a Nobleman who was searched, and no Stone felt; yet he was cut, and still the Surgeon could feel no Stone. He died the eighth Day; and when the Bladder was taken out of his Body, Thirty-two Stones were found, the smallest of which were as large as a Bean, and the largest weighed Half an Ounce, all alike in Colour, and every one involved in a distinct Membrane, which filled the whole Capacity of the Bladder, except a small Passage for the Exit of the Urine. Skenk. de Vef. Urin. Obs. cclxix.

Tulpius, in Lib. III. Obs. cclxix. mentions a Senator of Amsterdam who had Twenty-nine Stones, of different Sizes and Figures, found in his Bladder, each of which was wrapped up in a kind

kind of Capsula. The same Author relates the Case of ISAAC CAUBON, whose Bladder he calls Vesica Ringosa, in which a vast Number of Stones were found invested with Membranes. Vid. JOH. JACOB. MANGET. Theatrum. Anatom. Tom. I.

STEPHEN BLANCHARD opened Bodies wherein the Urinary Bladders were ulcerated with the Intestinum Rectum, and others full of purulent Matter, with Stones invested in Capsulæ.

The like Account we read in GUILHELM. FABRIC. HILDANUS's Observations, &c.

LECTURE XIII.

Of the ORGANS of MAN ſubſervient to GENERATION.

THE Parts of Generation in Males are of different Kinds; ſome of them being wholly contained in the Abdomen, and others externally. From this Situation, they might properly enough be divided into external and internal Parts; and all thoſe belonging to the firſt Claſs might be deſcribed before thoſe of the ſecond.

But it is ſtill more proper to have a Regard to the Oeconomy of theſe Parts, according to which their Functions begin in ſome internal Parts, are continued in ſome external Parts, return again to the internal, and are finiſhed in the external.

SPERMATIC VESSELS.

The ſpermatic * Arteries ariſe moſt commonly from the anterior Part of the inferior Aorta near each other, and about an Inch lower than the Arteriæ Renales. Their Origin oftentimes varies, as I have obſerved them to ariſe from the renal Artery; and ſometimes they exit higher, lower, or

* They ought more properly to be called teſtical Arteries, as they do no more than the others in conveying the Blood to be ſecreted.

more

more laterally, than is common; and each Artery has been ſeen to ariſe from other different Places.

They run down obliquely in the poſterior Part of the Abdomen, within the cellular Subſtance of the Peritonæum, paſſing inſenſibly from behind forward, and ſo parting gradually more and more from the Aorta, they croſs over the anterior Side of the Ureters, and run through the Apertures of the abdominal Muſcles along with the Elongations or Productions of the cellular Portion of the Peritonæum.

They are ſmall at their Origin, and in their Courſe downwards, and give off pretty conſiderable lateral Ramifications to the Membrana Adipoſa, Peritonæum, and alſo to the Meſentery, where they ſeem to communicate with the meſenteric Arteries.

They ſometimes paſs through the Areolæ of the ſpermatic Veins; and before they egreſs from the Abdomen, they are divided into very fine Rami, which run, in a more or leſs winding Courſe, almoſt parallel to each other.

Afterwards they enter the cellular Productions of the Peritonæum, which ſerve them for Vaginæ. They do not fluctuate indifferently from one Side to the other of theſe Vaginæ, but are connected along their inner Surface by thin membranous Laminæ, which are likewiſe Continuations of the cellular Subſtance of the Peritonæum.

The Arteries continue the ſame winding Courſe within theſe Vaginæ; paſſing before the Vaſa Deferentia, which are likewiſe contained in them, and at length terminate, by Ramifications, in the Epididymes and Teſtes.

The ſpermatic Veins accompany the Arteries, and have nearly the ſame Courſe. The right Vein ariſes commonly from the Trunk of the Vena Cava, in the ſame Manner as the Artery from the Aorta:

Aorta: And I have ſometimes obſerved it to riſe from the Union of the right renal Vein with the Vena Cava; and ſometimes I have ſeen three Veins on the right Side egreſs ſeparately from the Trunk of the Vena Cava: The left ſpermatic Vein ariſes commonly from the left renal Vein.

In their Courſe they firſt join the Arteries, and, together with them, enter the cellular Productions of the Peritonæum, to which they are connected in the ſame Manner: From their Origin to their Paſſage through the Apertures of the abdominal Muſcles, they ſend off ſeveral Rami to the Membrana Adipoſa of the Kidneys, Peritonæum, and Meſentery, where they ſeem to communicate with the Venæ Meſaraicæ, and conſequently with the Venæ Portæ.

A little below the Place where they traverſe the Ureters, they ſend out a conſiderable Branch, which is afterwards divided into two Rami, one of which communicates with the Vena Capſularis, and the other oftentimes with the Renalis; and lower down they give out the Vein, which communicates with the Vena Meſaraica, as already mentioned.

They differ from the ſpermatic Arteries, not only in that they are bigger, and their Tunics thinner; but alſo in being more divided and multiplied, as they deſcend to the Apertures of the abdominal Muſcles; and as they gradually produce a large Faſciculus of Ramifications (which the Antients named them) with the Arteries, Vaſa Pyramidalia.

Theſe Ramifications often communicate with each other in this Courſe, and form a great Number of Areolæ, Contortions, and Convolutions, ſo as to repreſent a kind of Plexus, which is connected to the cellular Vagina of each Side by very fine Lamellæ; and the Artery which accompanies the Vein croſſes it in ſeveral Places, and runs thro' the

the Areolæ in different Directions. These frequent Convolutions have given Rise to the Name of Vasa Pampiniformia, formerly given to these Vessels; and their particular Adhesions to each other at some Places made it believed, that there were real Anastomoses between the Artery and the Vein.

Leal Lealis, an Italian Anatomist, not considering the lateral Ramifications of the spermatic Arteries and Veins, thought he was able to demonstrate these pretended Anastomoses. The Experiments made by him, on living Animals, prove nothing to the Purpose. His Way was, to make a common Ligature on both Vessels, a little above the Testicle, and another on the Trunk of the Vein, after he had emptied it; then pressing the Aorta, to force the Blood into the spermatic Artery, the Vein, which he had before emptied, was found to be presently filled.

From thence he concluded, that the Course of the Blood to and from the Testicle, being obstructed by the inferior Ligature, there must be some Anastomoses between the two Ligatures, through which the Vein was supplied with Blood. But it is very plain, that this Effect was owing to the lateral Ramifications of the spermatic Artery and Vein, and not to his pretended Anastomosis. These fine lateral Ramifications were well known to Eustachius, but had escaped Leal Lealis.

Testes.

The Testes * are two glandular Bodies, situated near each other, without the Abdomen, below the In-

* These Organs are not always lodged within the Abdomen in the Peritonæum in a Fœtus, as Haller inferted in his Prim. Lin. Phyf. but only sometimes they remain, tho' very rarely, concealed in the inferior

Interſtice between the Groins in an Adult. The Antients named them Didymi, or Gemini. Their Size is nearly that of a Pigeon's Egg, and they are of an oval Figure, a little flatted on each Side. We may conſider in each Teſticle two Extremities, two Margins, and two Sides: One Extremity is ſituated anteriorly, and a little ſuperiorly, the other poſteriorly, and a little inferiorly; and their Margins lie ſuperiorly and inferiorly.

At the ſuperior Margin they have each an Appendix, called Epididymis, together with which it is involved in ſeveral Coverings; and they are both ſuſpended in a common one called the Scrotum.

Each Teſticle is a ſpermatic Gland formed by a vaſt Number of fine whitiſh Tubuli, folded and twiſted in different Manners, and diſtributed in various Faſciculi, between membranous Septa; and the whole being ſurrounded by a ſtrong common Covering, named Tunica Albuginea.

Theſe Septa are diſpoſed longitudinally, divaricating from each other on one Side, and approaching on the other. They approach each other along one Margin of the Teſticle, and terminate in a long narrow whitiſh Body, as in a kind of Axis.

From thence they divaricate in a regular Manner, and are fixed by their oppoſite Margins on the interior Surface of the Tunica Albuginea, of which

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ferior Part of the Abdomen, particularly in young Subjects; which have been taken for Tumors, or inguinal Herniæ: And, though improperly, Bandages were applied for that ſuppoſed Diſorder, which were of very bad Conſequence.

We read in BLASIUS's Obſerv. Med. Rarior. of a Man of Thirty Years of Age, who was ſaid to have three Teſticles; viz. two on the right, and one on the left Side, each of which had its particular Veſſels, and the ſame Bulk of Conformation.

The ſame Author ſays, he met with, in a Subject which had three Kidneys, two in the left, and one in the right Side; and each had its particular Ureter.

they appear to be a Continuation. This white Body may be termed the Nucleus of the Teſticle*.

From this Deſcription we ſee, that all theſe Septa are not of an equal Breadth; that the Interſtices between them are in ſome meaſure triangular; and that the Extent of the ſmall Tubes, which lie therein, muſt be very conſiderable. They have been reckoned to amount to many Ells †, by taking the Sum of all their ſeveral Portions; and they may be eaſily unfolded by a long Maceration, which deſtroys the delicate Subſtance by which all their Folds and Convolutions are connected.

All theſe Tubuli ſeem to terminate, by a ſmaller Number of common Trunks, at the white Body or Nucleus already mentioned; which Trunks afterwards pierce ſuperiorly the anterior Extremity of the Teſticle, and are diſpoſed in ſeveral Folds along the lateral external Part of the ſuperior Margin, all the way to the poſterior Extremity. From this Union ariſes a long whitiſh plaited Faſciculus called Epididymis.

The Epididymis thus formed, may be reckoned a Production of the Teſticle, or a kind of Teſtis Acceſſorius; and it reſembles, in ſome meaſure, an Arch ſupported by its Center. It is more contracted in the Middle than at the Extremities, by which it is cloſely united to thoſe of the Teſticle.

Between its Extremities it does not immediately touch the Teſticle, but is only looſely connected to it by the Duplicature of a very fine and almoſt tranſparent Membrane, as by a kind of Ligament. This Membrane is the Continuation and Dupli-

* Firſt deſcribed by HIGHMORE; whence it is named Corpus Highmori.

† BELLINI ſays about three Hundred; but they are more eaſily to untwiſt in Rats, than any other Animal I know of.

cature

cature of the Tunica Albuginea; which, having ſupplied the Place of a Ligament to the Epididymis, afterwards inveſts it.

The Epididymis is flat, a little concave on the inferior Side, or that next the Teſticle, irregularly convex ſuperiorly, or on that turned from the Teſticle; and theſe two Sides are diſtinguiſhed by two angular Margins; by the interior of which it is connected to the Teſticle in the Manner already ſaid, but the external Margin and flat Side are looſe and free.

The anterior Extremity or Head of the Epididymis ariſes from the Teſticle; and the poſterior Extremity, which likewiſe adheres very cloſely to it, is incurvated from the poſterior to the anterior, and a little ſuperiorly, and contracting, by Degrees, forms a particular Canal called Vas Deferens.

The Scrotum is the cutaneous Tegument of the Teſtes. Externally it is common to both, formed by a Continuation of the Skin of the adjacent Parts, and commonly very uneven, having a great Number of Rugæ on its external Surface. Interiorly it forms a muſcular Capſula for each Teſticle, called Dartos.

The exterior or cutaneous Portion of the Scrotum is nearly of the ſame Structure with the Skin in general, of which it is a Continuation; only it is ſomewhat thinner, and is likewiſe plentifully furniſhed with ſebaceous Glands, and Bulbs or Roots of Hairs.

Though it is a common Covering for both Teſticles, it is, nevertheleſs, diſtinguiſhed into two lateral Parts by a ſuperficial and uneven prominent Line, which appears like a kind of Suture, and from thence has been termed Raphe.

This Line is a Continuation of that which divides, in the ſame Manner, the cutaneous Tegument of the Penis, and it is continued thro' the

Perinæum, which it divides, likewiſe, all the Way to the Anus. It is only ſuperficial, and does not appear on the Inſide of the Skin.

The interior Surface of this cutaneous Saccus is lined by a very thin cellular Membrane, through which the Bulbs and Glands appear very diſtinctly when we view its Inſide. It increaſes in Size, chiefly, according to its Length; and then the Rugæ diſappear, more or leſs, according to the Degrees of the preternatural State or Indiſpoſition.

Dartos.

The Dartos, or muſcular Portion of the Scrotum, is a true cutaneous Muſcle; the Fibres of which are, for the moſt part, ſtrongly connected to the Skin, running through the cellular Subſtance which lies between theſe two Portions inſtead of a Membrana Adipoſa, but without the leaſt Appearance of Fat. This Muſcle is thin, and, by the Diſpoſition of its Fibres, forms a Capſula with two Cavities, or two ſmall Bags joined laterally to each other, and contained within the cutaneous Portion.

The lateral Parts of theſe two Capſulæ, which are turned from each other, are longer than thoſe which are connected; and by this Union a Septum is formed between the Teſtes, which may be called Mediaſtinum Scroti.

The Raphe or Suture, already mentioned, adheres to the Edge of this Septum, and thereby braces down the Middle of the cutaneous Portion, which from thence appears to have, in Part, two Cavities; and this, perhaps, was what gave Occaſion to make the French Word for the Scrotum to be in the plural Number. The other Edge of the Septum adheres to the Urethra.

The two Capſulæ of the Dartos are lined, on the internal or concave Side, by a cellular Subſtance more

more conſiderable than that between the convex Side and the Skin; ſo that the muſcular Fibres, all the Way to the Septum, lie between two cellular Strata. They run through the external Stratum, as has been ſaid, to be inſerted in the Skin, and by their Contraction they form the natural Rugæ of the Scrotum.

Theſe fleſhy Fibres have likewiſe a ſtrict Connection with the internal cellular Membrane, eſpecially at the ſuperior Part below the Groin, where the anterior and external lateral Portions of the Dartos terminate by a kind of tendinous or ligamentary Expanſion, which is ſtrongly united to the internal cellular Membrane. This is as a particular Faſcia Lata, which gives Inſertion to the Portions of the Dartos juſt mentioned, and as a broad Frænum which keeps the ſame Portions together.

The aponeurotic or ligamentary Expanſion of the Dartos is fixed in the Ramus of the Os Pubis, between the Muſculus Triceps and the Origin of the Corpus Cavernoſum of the ſame Side (which ſhall be deſcribed hereafter), all the Way to the inferior Part of the Symphyſis of theſe Bones. The internal Portion of theſe muſcular Capſulæ, or that which forms the Septum Scroti, is fixed to the Urethra by means of a Communication between the ſame ligamentary Expanſion and another; which ſhall be explained in its proper Place.

Vasa Deferentia

Are two white, ſolid, flatted Tubes, one lying on the right Side, the other on the left. From the Epididymis (which they are Continuations of) each of them runs up, in the cellular Vagina of the ſpermatic Veſſels, as high as the Apertures in the abdominal Muſcles; the ſanguiferous

Veſſels lying forwards, and the Vas Deferens behind them.

This Faſciculus, thus formed by the ſanguinary Veſſels, Vas Deferens, and their common Covering, is termed the Spermatic Cord. The Covering is ſmoother on the external than on the internal Side, and for that Reaſon it has been looked upon as a Vagina; the internal Subſtance of which is moſt cellular, and connects all the Veſſels together, while the external forms a Covering to inveſt them.

The Vas Deferens, having reached the membranous Lamina of the Peritonæum, where that Lamina runs over the Orifice of the Vagina, ſeparates from the ſanguiferous Veſſels, and runs poſteriorly, in Form of an Arch, in the cellular Subſtance of the Peritonæum, as far as the neareſt Side of the Bladder.

It paſſes afterwards behind the Body of the Bladder, to which it adheres very cloſely, as alſo to the Lamina of the Peritonæum which covers it, and then continues its arched Courſe towards the Cervix of the Bladder, where both Vaſa Deferentia meet, and their Curvatures terminate.

In this Courſe the Vas Deferens paſſes behind and croſſes the neighbouring umbilical Artery, and croſſes the Extremity of the Ureter of the ſame Side in its Paſſage between that Extremity and the Bladder; then, having got behind the Bladder, it meets the Vas Deferens of the other Side between the Inſertions of the Ureters, and they run down together to the Cervix of the Bladder.

This Canal, which at the Origin of the Epididymis is pretty large and plaited, becomes, immediately afterwards, ſmaller and ſmoother, and continues in that Form till it arrives behind the Bladder,

der, where it begins again to be larger and more uneven.

It arises from the angular Portion or posterior Extremity of the Epididymis, and from thence runs anteriorly, in a very oblique Course, on the half posterior Part of the Epididymis, where it is a little incurvated as it joins the posterior Portion of the spermatic Vessels.

The Texture of the smooth Portion of this Canal is very solid, and, in a Manner, cartilaginous, especially near the Surface of its Cavity, which, though very narrow, is still kept open by means of the Solidity and Thickness of its Sides.

The Cavity of the Vas Deferens is cylindrical, though the whole Tube is flat, and its external Circumference oval, as may be seen by cutting it transversly; and the Cavity inlarges as it passes behind the Bladder. The Termination of these Canals must be referred to the Description of the Urethra.

The particular Coverings of the Testes are commonly called Tunics; and they are three in Number: The Tunica Musculosa, named Cremaster, Vaginalis, and Albuginea. The two first are common to each Testicle, and to the spermatic Vessels which belong to it; and the third is peculiar to the Testicle alone.

The Tunica Vaginalis is the most considerable of the three, and must be described first, in order to conceive the Structure and Connection of the Cremaster, which is very improperly called a Tunic. The Albuginea has been already described with the Testes.

The Tunica Vaginalis is a Continuation of the Vagina of the spermatic Vessel, which, as it approaches the Testicle, is gradually dilated, and forms two Capsulæ, one contained within the other, the external being the longest and broadest

at the Bottom; ſo that there is a void Space left between them, in which the Teſticle is lodged.

This Structure may likewiſe be explained in the following Manner: The Vagina, having reached as low as the Teſticle, is divided into two Laminæ, the interior of which is the Bottom of the Vagina, and the exterior is expanded round the Teſticle, and gives it that Tunic called Vaginalis.

The internal Surface of this Tunic is lined by a fine Membrane, which ſtrengthens the Bottom of the Vagina, and forms a kind of Diaphragm, which prevents all Communication between the Vagina of the ſpermatic Veſſel and the Tunica Vaginalis of the Teſticle.

The Cremaſter, improperly termed a Tunic, is a thin muſcular Membrane, which runs down round the Vagina of the ſpermatic Veſſel, and terminates in the Tunica Vaginalis of the Teſticle.

It ſurrounds almoſt the whole Vagina, and afterwards expands itſelf on the ſuperior and external Part of the Tunica Vaginalis, into which it is inſerted, and terminates.

It ariſes partly from the Ligamentum Fallopii, and partly from the inferior Margin of the internal oblique Muſcle of the Abdomen; and on this Account it ſeems ſometimes to ariſe from the Spine of the Os Ilium; and it is probable that the Muſculus Tranſverſalis likewiſe contributes ſomewhat to its Formation.

It is covered by a very fine cellular Membrane, detached from the external Side of the Aponeuroſis of the Obliquus Externus, round the Opening commonly called the Ring. This Membrane is loſt in the cellular Subſtance of the internal Side of the Dartos.

From all this we ſee, that the Cremaſter is rather a Muſcle of the Tunica Vaginalis, than a particular Tunic. Thoſe among the Antients who be-

believed it to be a Tunic, called it Tunica Erythroïdes, from a Greek Word which signifies red; but this Muscle is not always red, neither is that Colour essentially necessary to a fleshy Substance.

The Corpora Cavernosa are two ligamentary and very limber Tubes, united laterally to each other, through the greatest Part of their Length, and solid at their two Extremities, two of which are connected, and rounded like the End of a Finger; the other two divaricate, like the Branches of the Greek Υ, and diminishing gradually in Size after the Divarication, terminate in an oblique Point. These divaricated and pointed Extremities may be called the Roots, and the round Extremities the Heads.

These two Bodies are almost cylindrical; being round, and of an equal Diameter from the Roots to the Heads; where they are, in some measure, conical. The ligamentary Substance of their Sides is elastic, and composed of fine compact Fibres, which are partly transverse, and partly more or less oblique.

The Cavity of these ligamentary Tubes is intirely lined by a strong cellular or cavernous Substance, which does not seem to be a Continuation of the lateral one. These Cells communicate with each other, and are always more or less full of Blood, resembling, pretty much, the cellular Substance of the Spleen; only with this Difference, that the Sides of the Cells are thicker in these cavernous Bodies, and without any additional Substance.

By the Union of the two Corpora Cavernosa, two external Sinuses are formed; one on the superior Side, the other on the inferior. The inferior Sinus is somewhat broader than the superior, and is filled, through its whole Length, by a third Tube,

Tube, narrower than the Corpora Cavernoſa, called the Urethra.

The Roots of the Corpora Cavernoſa are each fixed to the Margin of the ſmall Ramus of the Oſſa Iſchium and Pubis. They meet at the Symphyſis of the Oſſa Pubis, where each of them becomes a cylindrical Tube, and unites with the other in the Manner already ſaid.

The Heads, or rounded Extremities, connect the Baſis of a diſtinct Body, called the Glans, which is an Expanſion of the Urethra, and cloſely united to it in the Manner which ſhall be explained.

By the Union of the Corpora Cavernoſa from their Roots to their round Extremities or Heads, a particular Septum is formed by the tranſverſe Fibres of both. Between the Fibres of this Septum, ſeveral ſmall void Spaces are left, by which the Corpora Cavernoſa communicate with each other; and therefore, by blowing into one of them, we preſently inflate the other. Towards the rounded Extremities, the Septum diminiſhes every Way.

The Urethra is the third ſpongy Tube which compoſes the Penis, and adheres to the Corpora Cavernoſa through the whole Length of the inferior Sinus formed by their Union. It differs from the other two, both as it is narrower, and as it forms a concave Canal. Its Subſtance is ſpongy or cavernous, except a ſmall Portion next the Bladder, and its internal and external Surfaces are membranous.

It is, at firſt, no more than a membranous Canal continued from the anterior Opening of the Bladder at the Place called the Neck, which is a Name that would be more proper for this Portion of the Urethra.

About

About a Finger's Breadth and a Half from its Origin, it connects a cavernous Substance like that of the two other Tubes, only smaller, which surrounds it through the whole Extent of the inferior Sinus of the Corpora Cavernosa.

But before this spongy Substance begins to surround the Urethra, it forms a distinct oblong Body which is connected only to the inferior convex Side of the Canal, and afterwards, being divided on each Side, invests it quite round: This Body is called the Bulb of the Urethra; being larger than any other Part of that Canal, and divided interiorly, by a very fine membranous Septum, into lateral Parts; and therefore, when it is inflated, it appears to be double, or with two Heads.

The first Portion of the Urethra, or that which is not covered by the cavernous Substance, and which, from the Bladder to the Bulb, is only a membranous Canal, is sustained by a large, solid, whitish Mass, of the Figure of a Chesnut, situated between the Bladder and the Bulb of the Urethra, its Basis being towards the Bladder, the Apex towards the Urethra, and the Sides lying superiorly and inferiorly.

This Body is named the Prostates, from a Greek Word which expresses its Situation before the Vesiculæ Seminales, and implies a Plurality, because it appears to be divided into two lateral Lobes by a concave Sinus, which runs through its superior Side from the Basis to the Apex. The first Portion of the Urethra lies in this Sinus, adhering very closely to the Prostates which surround it.

The Body of the Prostates lies on the Intestinum Rectum, and the Apex is under the internal Labium of the cartilaginous Curvature of the Ossa Pubis. The internal Substance is spongy, but very compact; and in each Lobe there are several Folliculi which open into the first Portion of

the Urethra, towards the Bottom of the Sinus, as ſhall be ſhewn. The ſmall Portion of the Urethra between the Apex of the Proſtates and the Bulb, perforates the interoſſeous Ligament of the Oſſa Pubis: This Portion is very ſhort, its Length being no more than what is ſufficient to paſs thro' the Foramen in the Ligament, the poſterior Side of which, conſequently, touches the Apex of the Proſtates, and its anterior the Bulb of the Urethra. This Portion might be called the Cervix of the Urethra, and that which lies between the Body of the Bladder and the Proſtates might be called, more properly, the Cervix of the Bladder.

The ſpongy Subſtance of the Urethra, having reached the Extremity of the Corpora Cavernoſa, forms a large Head, called the Glans, which crowns the three ſpongy Pillars; with this Difference, however, that it is a Continuation of the ſpongy Subſtance of the Urethra, and only adheres to the Extremity of the Corpora Cavernoſa without any direct Communication.

It is for this Reaſon, that, if we blow into the ſpongy Subſtance of the Urethra, the Glans is preſently inflated, and no Air paſſes into the Corpora Cavernoſa; but when we blow into one of theſe Bodies, the Air paſſes immediately into the other, the Urethra and Glans remaining as they were.

The Figure of the Glans is that of a rounded Cone, a little flattened inferiorly, and with an oblique prominent Baſis, the Circumference of which is ſomewhat greater than that of the Corpora Cavernoſa.

The ſpongy Subſtance of the Glans is thick and uniform next the Corpora Cavernoſa, but next the Urethra it is perforated by a Continuation of that Canal, and is there no thicker than the Urethra before the Formation of the Glans.

There-

Therefore the Canal of the Urethra does not lie in the Middle of the Glans, but continues its direct Courſe through the inferior flat Side of it towards the Extremity, where it terminates by an oblong Orifice.

All the convex Surface of the Glans is covered by a fine villous Subſtance, and again by a fine Membrane reſembling the red Part of the Lips. The Circumference of the Baſis of the Glans has a double Row of ſmall Papillæ, which may be reckoned ſebaceous Glands, from which a thick Matter is diſcharged.

We have ſeveral Things to take Notice of in the Cavity of the Urethra, at the Bottom of which, the firſt Portion, or that which lies within the Proſtates, there is a ſmall, oblong, oval Eminence, pretty large on the poſterior Part, and terminating anteriorly in a Point, called Caruncula, or Verumontanum. The large Portion of it is commonly perforated by two Apertures, ſometimes only by one, and very ſeldom by three; and theſe are the excretory Orifices of the Veſiculæ Seminales. Each Orifice has a ſmall thin membranous Margin, which may ſerve for Valves to the excretory Ducts of the Veſiculæ.

On each Side of the large Portion of the Caruncula there are five or ſix Apertures, ranked in Form of a Creſcent round its lateral Parts, which are the Orifices of the excretory Ducts of the Proſtates which come from the Folliculi already mentioned, and run in an oblique Courſe to the Orifices, in a kind of membranous Duplicature.

The Veſiculæ Seminales are ſoft whitiſh Bodies, about three or four Fingers Breadth in Length, one in Breadth, and about three Times as broad as thick, ſituated obliquely between the Rectum and the inferior Part of the Bladder, in ſuch a Manner, as that their ſuperior Extremities are at a Diſtance from

from each other, and their inferior Extremities united between thoſe of the Vaſa Deferentia, of which they imitate both the Obliquity and the Incurvation.

They are irregularly round ſuperiorly, and their Breadth decreaſes gradually from thence. By the Union of their inferior Extremities they form a kind of Fork, the Branches of which are broad, and bent like Rams Horns: Theſe Extremities are very narrow, and form a ſmall Cervix, which runs behind the Bladder towards its Orifice, and continues its Courſe in the Sinus of the Proſtates, through the Subſtance of the contiguous Portion of the Urethra, till its Extremities pierce the Caruncula in the Manner already ſaid.

The internal Subſtance of the Veſiculæ is plaited, and, in a Manner, diſtinguiſhed into ſeveral Capſulæ by contorted Folds. Their external Surface is covered by a fine Membrane which ſerves for a Border and Frænum to the Folds, and is a true Continuation of the cellular Subſtance of the Peritonæum. The Veſiculæ may eaſily be unfolded, and all their Contorſions ſtreightened; and, by this means, they become much longer than in their natural State.

Their inner Surface is villous and glandular, and continually furniſhes a particular Fluid, which exalts, refines, and perfects, the Semen, which they receive from the Vaſa Deferentia, and of which they are the Reſervatories, for a certain Time.

The Paſſage of the Vaſa Deferentia into the Veſiculæ is very particular. It has been already obſerved, that theſe Canals are incurvated behind the Bladder; and that their contracted Extremities unite at that Place. They unite in an Angle, and run between the contiguous Extremities of the Veſiculæ; and this Union is ſo cloſe, that the

ad-

adhering Portions seem to form only one middle Septum, between two small Tubes, each of which is formed partly by the Extremity of one Vas Deferens, and partly by that of the neighbouring Vesicula.

This lateral Union of the Extremities of the Vas Deferens and Vesicula Seminalis on each Side, forms likewise a kind of short Septum, which terminates in a Crescent, like a small semilunar Valve, and the Extremity of the Vas Deferens is narrower than that of the Vesicula. By this Mechanism, the Fluid contained in each Vas Deferens has Liberty to enter the contiguous Vesicula; but that contained in the Vesicula cannot return into the other Canal*.

Afterwards the two small Tubes, each formed by the Extremities of the Vas Deferens and Vesicula, run in between the Basis of the Prostates and Canal of the Urethra; and perforating the Sides of that Canal obliquely, they terminate in the Caruncula in the Manner already said.

The Inside of the Canal of the Urethra is lined by a fine Membrane full of capillary Vessels, and its Surface is perforated by a great Number of oblong Apertures, or small Lacunæ, of different Sizes, the largest lying near the Glands.

These Lacunæ, or Orifices of the excretory Ducts of the same Number of small Glands, are dispersed through the Substance of the Urethra; which Ducts run, for some Way, in the spongy Substance, along the convex Side of the internal Membrane of the Urethra, and open obliquely, from behind forwards, into the great Canal. The

* If we blow into one of the Vasa Deferentia, after having compressed the Urethra, the Air inflates the contiguous Vesicula Seminalis and the Bladder of Urine, without passing into the Vesicula, or Canal of the other Side, except we blow with too great Violence.

Margins

Margins of the Lacunæ are ſemilunar, or like a Creſcent, becauſe of the Obliquity of their Opening.

A little way from the Beginning of the cellular Subſtance of the Urethra, we meet with two Lacunæ more conſiderable than the reſt, and their Ducts are very long: Theſe Lacunæ and Ducts lead to two glandular Bodies, ſituated on the two convex Sides of the ſpongy Subſtance of the Urethra near the Bulb. Each of them is about the Size of a Cherry-ſtone, but they are oblong and flat, and covered intirely by the Muſcles called Acceleratores. Theſe two Bodies are commonly called Proſtatæ Inferiores; but if their Situation be carefully examined, they will be found to be higher than the true Proſtates. There is a third Body of the ſame kind ſituated more anteriorly.

The Cavity of the Urethra reſembles, nearly, that of a ſmall writing Pen. It is not every-where round; and towards the Gland becomes broader and flatter on each Side, eſpecially in the Gland itſelf, where there is a kind of oval or navicular Foſſula.

This Canal terminates at the Extremity of the Glans by a narrow oblong Orifice, or Fiſſure, which is much leſs than the reſt of the Cavity: The Commiſſures of this ſmall Fiſſure are turned one towards the convex, the other towards the flat Side of the Glans, and the Labia of the Fiſſure are its lateral Parts; and it ſeems to be ſurrounded by fleſhy Fibres.

The Integuments which cover all theſe Parts are three or four in Number. The firſt is the Skin, with the Cuticula; the ſecond is the common cellular Membrane, which, in this Place, ſeldom contains any Fat; the third is termed nervous; and the fourth is a particular cellular Membrane, which is not always to be found.

The

The first of these Integuments, the Skin, is a Continuation of that of the Pubis and Scrotum, and adheres to the second all the way to the Basis of the Gland where that second Integument ends. The rest of the cutaneous Integument covers the Glans without Adhesion, and terminates by an Opening: This Portion is named Præputium Posterior; and along the whole inferior or back-Side, both of the whole Integument in general, and of the Præputium in particular, there runs a fine Suture, which is a Continuation of the Raphe of the Perinæum and Scrotum.

The internal Surface of the Prepuce is lined with a fine Membrane from the Opening all the way behind the Basis of the Glans, and the same Membrane is folded from behind forward, round the Glans, forming the proper Integument thereof, and covering, very closely, its whole villous Surface as far as the Orifice of the Urethra, where it joins the Membrane which lines the Inside of that Canal.

This proper Membrane of the Glans, and internal Membrane of the Prepuce, form conjointly along the flat Part of the Glans; from its Basis to the Orifice of the Urethra, a membranous Duplicature, which is like a Septum or Mediastinum, divides this Part into two lateral Portions, and limits the Motions of the Præputium; for which Reason it is called Frænum Præputii.

The Surface of the internal Membrane of the Prepuce discharges a Fluid which prevents it from adhering to the Glans, and perhaps serves likewise to dilute that which is collected at the Basis of the Glans, from the Glandulæ Sebaceæ already mentioned.

The second common Integument of these Parts is nearly the same with what is every-where found

under the Skin, except that it is not filled with Fat, and that it is more fibrous than cellular, and a little loose. It accompanies the Skin to the Basis of the Glans, as has been already observed.

The third common Integument, improperly called Tunica Nervosa, is of a firm, elastic, ligamentary Substance, and its Fibres are sometimes of a yellowish Colour. It invests the Corpora Cavernosa and Urethra from the Glans to the Symphysis of the Ossa Pubis; and at some Distance from these Bones, it forms, on the superior Sinus of the Corpora Cavernosa, a close Duplicature: By this Means, a flat broad Ligament is raised, which runs directly superiorly, and is inserted in the forementioned Symphysis, as far as the tendinous Basis of the abdominal Musculi Pyramidales.

This Ligament has been called Ligamentum Elasticum, because it yields, and recovers itself; and Suspensorium, because it suspends these Parts by means of its Insertion into the Symphysis. It sends off a Detachment, or Ala, towards each Side, one Margin of which is fixed between the Musculus Triceps and the Corpus Cavernosum, and forms the ligamentary Expansion in which the Dartos is inserted, as has been already said. It seems likewise to send down another Elongation directly to the Perinæum and Anus.

The fourth Integument of these Parts is the Tunica Cellulosa of Ruysch, which immediately surrounds the Corpora Cavernosa and Urethra, lying between these and the third Integument, from which it seems to be distinguished only by the Closeness and Fineness of its Texture; and it is sometimes hardly perceptible.

The Muscles that are inserted in these Parts, are five Pairs: Two for the Corpora Cavernosa; two for the Urethra; two common Muscles, called Transs-

Transverſales; and four ſmall ones for the Proſtates.

The firſt two Muſcles are commonly called Erectores, but might be more properly named Iſchio-Cavernoſi: The next two are called Acceleratores; but the Name of Bulbo Cavernoſi would better agree with them: The four ſmall Muſcles, two of which are ſuperior, and two inferior, may be called Proſtatici. It was obſerved, at the Beginning of the Deſcription of the Muſcles, that the Names, taken from the ſuppoſed Uſes, are very equivocal.

The Muſculi Iſchio-Cavernoſi lie along the Roots of the Corpora Cavernoſa; each of them being fixed by one Extremity very obliquely, in the internal Labium of the Ramus of the Os Iſchium, from the ſuperior Tuberoſity: From thence it accompanies the Root of the Corpus Cavernoſum all the way to the Symphyſis of the Oſſa Pubis, and is fixed, by its other Extremity, in the Corpora Cavernoſa, near their Union; where the Fibres of both Muſcles meet, and are reciprocally expanded over both Corpora. They lie a little lower, and more interiorly than the Roots of theſe cavernous Bodies.

Winslow deſcribes two other Muſculi Acceſſorii, which he looked upon as lateral Acceleratores, or as Acceleratores Acceſſorii; fixed lower, and more interiorly, in the Os Iſchium, than the former, which they accompany all the way to the Corpora Cavernoſa; and then, leaving them, they are inſerted chiefly in the Urethra, near the Bifurcation of the Muſculus Bulbo-Cavernoſus.

Theſe Bulbo-Cavernoſi, commonly called Acceleratores, form, firſt of all, a penniform Muſcle, by means of a middle Tendon, fixed in the inferior Part of the interoſſeous Ligament of the Oſſa

Pubis, and to the Union of the Muſculi Tranſverſales, with the Sphincters of the Anus; from which they paſs, in an expanded Form, over the Bulb of the Urethra, covering that Bulb and the Urethra itſelf, and adhering, in ſome meaſure, to both, as high as the Origin of the Ligamentum Suſpenſorium, the middle Tendon anſwering to the Septum of the Bulb.

Afterwards the two Laminæ ſeparate, and run obliquely to the right and left Hands from behind forwards, and from below ſuperiorly; ſurrounding the Corpora Cavernoſa, into the external Sides of which they are inſerted. The middle Tendon adheres very ſtrongly to the inferior Part of the Septum of the Bulb, in which, and in the Urethra itſelf, ſeveral of the Fibres of theſe Muſcles are fixed.

The Muſculi Tranſverſi, called alſo Triangulares, are two long, narrow, fleſhy Faſciculi, inſerted each, by one Extremity, in the Root or Beginning of the Ramus of the Os Iſchium; from whence they run, tranſverſly, along the Margin of the interoſſeous Ligament of the Oſſa Pubis, as far as the Apex of the Proſtates, where their other Extremities meet, and commonly form a kind of digaſtric Muſcle, the Middle of which gives Inſertion to the Muſcles of the Urethra, and to the cutaneous Sphincters of the Anus.

The ſuperior Proſtatici are two thin Lamellæ fixed in the ſuperior Part of the interior Side of the ſmall Rami of the Oſſa Pubis, from whence they are ſpread over and inſerted in the Proſtates. Their Inſertions in the Oſſa Pubis are on one Side of thoſe of the Obturatores Interni.

The Proſtatici Inferiores are ſmall tranſverſe Laminæ, each of which is fixed in the Symphyſis, between the Ramus of the Os Pubis and Os Iſchium,

chium, and from thence runs tranſverſly till it meets its Fellow from the other Side under the Proſtates, to which they are both ſtrongly connected; and they ſerve like a Girth to ſuſtain theſe Glands. They may be conſidered as two ſmall or internal Tranſverſales, and the other two Tranſverſales may be diſtinguiſhed by the Names of great, or external: They have likewiſe ſome Adheſions to the Point in which all theſe Muſcles, hitherto deſcribed, are united.

The ARTERIES of theſe Parts come chiefly from the internal Iliacs or Hypogaſtrics, and the reſt from the Iliacæ Externæ or Crurales. The principal Arteries are termed Pudicæ; one of which is external, the other internal.

The Pudicæ Externæ ſend a Branch to each Side, which, having paſſed out of the Pelvis by the Side of the Os Sacrum, runs on the internal Side of the Tuberculum Iſchii to the Roots of the Corpora Cavernoſa, along the internal Side of the Muſculi Iſchio-Cavernoſi, or Erectores. It ſends Ramifications to the bulbous Head of the Urethra, and to the Corpora Cavernoſa; and, together with the Glutæa, with which it communicates in its Paſſage, it likewiſe ſupplies the Scrotum.

The Pudicæ Internæ, having furniſhed the Inteſtinum Rectum, Bladder, Veſiculæ Seminales, and Proſtates, communicate with the Hæmorrhoïdales, paſs under the Curvature of the Oſſa Pubis, partly enter the Corpora Cavernoſa, and partly run along the ſuperior Side; ſending off ſmall lateral Branches, which ſurround theſe Bodies, like irregular Semicurvatures, and penetrate them by numerous Ramifications.

The crural Arteries ſend each likewiſe a Branch, which, running behind the contiguous crural Vein, is diſtributed to the Integuments of the Penis, by

the Name of Pudica Externa, and communicates, by lateral Ramifications, with thoſe of the Pudica Interna. Theſe Communications are not only between the internal and external Pudicæ of the ſame Side, but alſo between thoſe of both Sides, which reciprocally communicate with each other.

The Diſtribution of the Veins follows nearly that of the Arteries, but they have more Ramifications and Communications, as in other Places. The principal Vein is that which paſſes directly under the Symphyſis of the Oſſa Pubis between the two Arteries, and runs along the whole ſuperior Sinus formed by the Union of the Corpora Cavernoſa. It is very large, often double, and very ſeldom triple; but the Trunks do not ſeparate whilſt in the Sinus; and it has a great Number of Valves.

This great middle Vein is formed by the Union of the hypogaſtric Branches, which, after paſſing on the two internal Sides of the Pelvis, meet about the Middle of the Curvature of the Oſſa Pubis; where we obſerve a venal Plexus, which covers the ſuperior convex Side of the firſt Portion of the Urethra, before it is ſurrounded by the ſpongy Subſtance.

The ſpermatic Veſſels, already deſcribed, from their Origin and Termination out of the Abdomen, having reached, on each Side, near the Teſticle, are divided into two principal Faſciculi, one of which is larger than the other. The largeſt is the anterior, and is diſtributed through the Teſticle by a prodigious Number of very fine capillary Ramifications, which accompany all the Convolutions and Folds of the ſmall Canals.

The other Faſciculus is poſterior, and diſtributed to the Epididymis in the ſame Manner.

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The ſpermatic Artery is accompanied by a Ramus of the epigaſtric Artery, which runs down, on the Side of it, as far as the Teſticle, where they communicate reciprocally with each other. There is ſometimes a ſmall Ramus of the hypogaſtric Artery, which accompanies the Vas Deferens to the Epididymis, and there communicates with the Arteria Spermatica.

The Nerves of theſe Organs come from the Lumbares and Sacri, and communicate with the Sympatheticus Maximus and Plexus Meſenterici. Near the Curvature of the Os Pubis they form together, on each Side, a particular Branch, which paſſes under that Curvature along the ſuperior Side of the neighbouring Corpus Cavernoſum, near the Artery already mentioned.

In their Paſſage over the Corpora Cavernoſa, they ſend off a great many Rami, which ſurround theſe Bodies on all Sides, between the Skin and ligamentary Integument; being ſo diſpoſed, as that the Arteries lie between them and the middle Vein. They muſt be examined preſently after the Skin has been raiſed; becauſe, when the Ramifications are dried by the Air, they diſappear.

There are two Nerves which accompany the ſpermatic Veſſel; one of which comes from the Nervi Lumbares, near the anterior Spine of the Os Ilium, which is incurvated in its Paſſage out of the Abdomen through the Muſcles, and ſerves to diſtinguiſh the Cremaſter; the other comes from the Plexus Renalis.

There is likewiſe one Nerve on each Side, which, being produced from the Union of the ſecond, third, and fourth Pairs of the Nervi Sacri, eſpecially from the third, goes out of the Abdomen above the Ligamentum Iſchio-Sacrum, paſſes by the Inſide of the Tuberoſity and ſmall Branch of the Os Iſchium, and is diſtributed to the Corpora

Cavernoſa, the Muſcles belonging to them, and to the adjacent Parts*.

The Erection of the Penis is commonly ſaid to be by the Compreſſion of either its large or ſmall Veins, which every-where open within its cavernous Subſtance, to hinder theſe Veins from abſorbing and returning the Blood from the Arteries.

However, it may be effected, 1. By the levator Muſcle drawing up the proſtate Glands; but it is very probable, that, as we ſee in the Nipples of ſuckling Women, and in the Bluſhing or Redneſs of the Face, and Paſſions of the Mind; from theſe it is probable, that the Courſe of the Blood through the Veins may be retarded, without the immediate Uſe of any Muſcle; that is, by the latent Power of a Multitude of ſmall nervous Bridles, by whoſe Conſtriction, from the Force of Pleaſure, the Veins are compreſſed and ſtreightened, ſo as to return leſs Blood, at that Time, than what is brought in by the Arteries. But the Cauſe of this Conſtriction in the nervous Bridles or Sphincters themſelves, depends on a various Irritation of the Nerves of the Penis and Urethra, either from an external Friction, or venereal Thoughts.

A long-continued and violent Erection is commonly followed, at laſt, by an Expulſion of the Semen; when, at length, the cellular Spaces of the Urethra, and its continuous Glands, which are at laſt filled, become ſo far diſtended with a large Quantity of warm Blood, that the nervous Papillæ, ſtretched out in the latter, become violently affected from the Irritation, or otherwiſe; which cauſes the Veſiculæ to void the Semen by the levator Muſcles of the Anus, which preſs them

* The Semen Maſculinum ſhall be explained in the Lecture upon Conception.

againſt

againſt the reſiſting Bladder with a convulſive Motion, excited either by a voluptuous Imagination, or a Pruritu, which is exquiſite in the Nerves of the Glans. Wherefore the Semen is never diſcharged with the Urine, in a good State of Health; becauſe its Expulſion requires the Bladder to be conſtricted. For, whilſt flaccid, it affords little or no Reſiſtance to the Veſiculæ Seminales. At the ſame Time, with the Levatores, acts the Compreſſor of the proſtate Gland, and the tranſverſe Muſcles; ſoon after, the contractive Powers of the Urethra are, from the Irritation of the very ſenſible Fabric of this Canal, put into Action. This Contraction conduces principally from the accelerator Muſcles, which makes a powerful Concuſſion to the Bulb and adjacent Part of the Urethra, ſo as to propel the Contents more ſwiftly, in Proportion as the Bulb has a larger Diameter than that of the Urethra.

But this may act firmly on the Sphincter of the Anus, in Conjunction with that of the Bladder, it muſt be well cloſed up. The accelerator Muſcles ſeem chiefly to be concerned in the Erection, by compreſſing the Veins of the Corpora Cavernoſa of the Urethra at the ſame Time with the other Muſcles belonging to this Organ. Thus the Semen is ejected impetuouſly. This Action is like Convulſions, when too frequently and freely practiſed, weakens the whole Habit, and therefore very much injures the nervous Syſtem. HALLER.

SHEBBEARE ſays*, in imagining that the Blood is the Cauſe of the Erection of the Penis, there is yet no Reaſon aſſigned why it is not always erect; or, when it is, how it becomes flaccid after-

* See his Practice of Phyſic; wherein he endeavours to ſhew, that all the Functions of the animal Oeconomy are cauſed by Degrees of Heat, or Fire, as he called them.

wards;

wards; and why the Blood passes through it sometimes, and not always. So that, in saying the Blood is the Cause of this Erection, without telling how it is done, is no Explanation at all. Here, I think, is a farther Proof of the vital Fire's acting in us. The Mind, then, being excited, either from Love, or whatever else may cause it, to the Act of Venery, the vital Fire passes to the Corpora Cavernosa, and distends its Cells in the same Manner we see it at the Time of Erection.

Now if the Blood passes into the Corpora Cavernosa, it must be by means of this vital Fire's first distending these Cells; otherwise it would not always pass. But I believe that it never does pass at all; and that the whole Distension is owing to the vital Fire.

This perhaps may be the Reason, why all Animals, after Coition, are dull, &c. the vital Heat, which, as has been explained, is the Cause of Motion, being diminished by the Vigour of this Action, which demands more than the common Offices of Nature; there succeeds, for a few Moments, a small Faintness about, and a Dejection from, the Want of a sufficient Quantity of Heat to give it the usual Dilatation. And this also will assign some Reason why a Repetition of the venereal Act depends on the Health and Vigour of the Person; and why it cannot be repeated ad libitum; viz. The vital Power, being too much exhausted, and the Fluid in the Cells of the Corpora Cavernosa dissipated by the repeated Action; and both these are in Proportion to the State of Health.

Thus it may be easily conceived how the Penis becomes erect at certain Times, and at other Times flaccid, by means of the Presence or Absence of the vital Heat.

Professor Du Veney was the first who took Notice that the spermatic Arteries arise from the Aorta,

Aorta, which is itself placed under the interior Lamella of the Peritonæum on the external Surface of the Cavity of the Abdomen; but that the Peritonæum, being equally expanded on all Sides, forms a Cavity, in which the abdominal Viscera are contained; but that the Aorta is situated under the Extremity of that Cavity. But we see, that the spermatic Vessels are likewise placed on the external Surface of the Membrane of the Peritonæum, in which Manner they pass through the Apertures of the abdominal Muscles, which here leave the Orifice for the Course of the spermatic Vessels. These Apertures are covered by the Peritonæum, which yet does not pass through them together with the Vessels which it serves only to cover: Therefore the Peritonæum is here extremely thin, and liable to true Herniæ, extended into a Sacculus without bursting; which Sacculus, being protruded by the Sides of the seminal Vessels, enters the Scrotum without including those Vessels. When this Sacculus contains Water, it is called an Hydrocele, Pneumatocele, Omentum, Epiplocele; or if any Portion of the Intestines, an Enterocele.

From hence it evidently appears, why Herniæ happen so frequently in these Parts; and that the Disorder is nothing else than a Dilatation, with Protrusion, of the Parts through the Apertures of the abdominal Membranes, so as to form a Sacculus, or Cavity, which is improperly called a Rupture; since the Peritonæum is only dilated laterally into the Form of a Bag.

From hence it is easy to conjecture, why those, who are subject to this Disorder, are frequently sterile; as the spermatic Vessels often adhere to the hernial Sacculus; which, if thrust into the Abdomen, the Testicles are, at the same Time, drawn up, whence Convulsions follow.

Dis-

OBSERVATIONS.

Diſeaſes of the Scroti are a Collection of extravaſated Lympha, or Serum, lodged in the cellular Membrane of the Scrotum, and are divided into two Kinds; viz. one produced by Filtration, or Tranſudation; the other by Effuſion. Of the firſt Species is that where the Urine fills only the cellular Texture of the Scrotum and the Tunica Vaginalis; the other Kind of Hydrocele is when the Lympha is collected in a ſingle Cavity, as in a Cyſtis; which ſometimes cauſes the Scrotum to be extended as large as the Bladder; which, if not ſoon remedied, will prove of very bad Conſequence to the Teſticles, &c.

The Spermatocele is a Diſorder which ariſes from an Obſtruction of the Semen in the Vas or Vaſa Deferentia, moſt commonly proceeding from venereal Diſeaſes; I ſuppoſe by the Communication of the lymphatic Veſſels.

The Teſticles, and their Integuments, may be affected with the ſame Diſeaſes as the other ſoft Parts; and, beſides theſe, they have likewiſe Diſorders peculiar to themſelves. They may proceed from external Cauſes; as Blows, Compreſſion, Puncture, Inciſion; or they may ariſe from a general vitiated State of the Fluids; and ſometimes from a ſimple Obſtruction only; the Fluids being then no otherwiſe in Fault, than merely from a Defect in their Circulation: At other Times they are produced from a Change in the State of theſe ſuppreſſed Fluids, and oftentimes from a critical or ſymptomatical Defluxion upon theſe Parts, proceeding from a venereal or cancerous Virus.

A Diſorder of the Teſticles, therefore, may be ſimple: It may become otherwiſe by the Corruption of the Fluids which ſtagnate there; and, if ariſing

arising from an internal Virus, it may be complicated with other Symptoms proceeding from the same Taint.

Most Authors have comprehended all these Diseases under the general Name of Sarcocele; as if, in Consequence of such Diseases, the Testicle became a fleshy Substance, and troublesome no other ways than by its increased Bulk: But daily Experience shews us, that these Disorders are very different one from another; and we see that even each particular Species of them is liable to many Changes and Alterations: Those which appear most simple, and are produced by external Causes, sometimes degenerating into a Carcinoma and a Cancer.

These Disorders, in their first Appearance, cannot, without Difficulty, be distinguished, as to their Nature, unless the true Cause be discovered by preceding Circumstances, or by their being attended with some other Illness arising from the same Source. In general, therefore, it is from their Progress, only, that we are able to discover their true Characters. This Progress of theirs may be more or less quick, and in their Consequences more or less considerable: Thus the Tumor may remain a long Time schirrous, without increasing much; or it may increase in a little Time, and still retain the Nature of a Schirrus. It may change likewise, very soon, to a carcinomatous State; and may not degenerate into a Cancer but imperceptibly, and after a long Continuance. The Swelling, as it increases, may also extend to the spermatic Vessels: And this is what is most to be apprehended; especially if it is disposed to carcinomatous, or is become so by the Corruption of the Fluids therein confined.

I have known the spermatic Vessels very much inlarged, and sometimes hardened, not only under the

the external Apertures, but alſo extending conſiderably higher into the Abdomen: In other Caſes I have obſerved, that theſe Veſſels ſeemed ſound from the Teſticle to the Aperture; but, by tracing and carefully feeling it through the Skin and the abdominal Muſcles, I have diſcovered ſome ſmall Tumors, here and there, ſhaped like Olives, proceeding from the ſame Cauſe, and being of the ſame Nature with the Diſorder of the Teſticles: I have likewiſe ſeen another Inſtance of theſe Tumors which grew within the Cavity, and, ſwelling even to the Size of one's Head, killed the Patient in leſs than ſix Months. Le Dran's Surgery.

The moſt common Diſeaſes of the Penis ariſe from a Coition with infected Women, which generally afterwards proceeds from Gonorrhæas, Shancres, or inguinal Buboes.

This Diſtemper begins, and makes its Progreſs thus, ſooner or later, according as the Woman, with whom the Man has had Converſation, was more or leſs infected; and likewiſe according to the Conſtitution, which in ſome are more apt to receive than others.

The firſt Symptoms are; the Patient is ſeized with Pains in the Genitals, and a kind of Senſation like a Rotation, in the Teſticles: Afterwards, if the Prepuce is conſtantly over the Glans, there ariſes an Eruption, or Puſtules, which, in Sizes, Colour, and Figures, reſemble Spots of the Meaſles; preſently after appears a weeping yellowiſh Matter, till at length, if the Diſeaſe be highly virulent, it aſſumes a greeniſh Hue, ſomewhat like a thin ſanious Matter.

Theſe Puſtules at length become Ulcers commonly called Shancres, which continually corrode the Parts whereon they are fixed; and, if proper Care be not taken, they harden, and become callous.

Some-

Sometimes the Urethra is eroded and excoriated by a long Running of acrimonious Pus, which creates a ſoft ſpongeous Subſtance to ſupply the Defect; which, by continually increaſing, forms Caruncles or Carnoſities, which very often obſtruct the urinary Paſſage.

It likewiſe often happens through ſome violent Motion, or ill Management of a Gonorrhæa by the Uſe of Aſtringents too ſoon, which hinder a proper Diſcharge, that the Diſeaſe falls into the Scroti, and inflames the Teſticles.

We may add here the Phymoſis, which Diſeaſe is a Contraction of the Prepuce over the Glans; which, being inflamed, cannot be drawn back from the Glans of the Penis.

The Paraphymoſis is the reverſe of the Phymoſis, which is the Prepuce's being contracted, and cannot be brought to cover the Glans of the Penis.

There are alſo ſometimes aqueous Veſicles, named Cryſtallines.

Women are very near ſubject to as many Symptoms as Men; their chief Complaints being a Difficulty of making Water, with a Running: Nevertheleſs, they are liable to Shancres and venereal Warts, as well internally as externally, on the Parts of the Labia Pudendi; likewiſe to Buboes, and a Conſtriction of the Sphincter of the Vagina, conſtructing the external Orifice, as a Phymoſis in Men.

The true Communication of this Infection is abſorbed by the lymphatic Veſſel, and obſtructed in the adjacent Glands of the genital Parts firſt, and proceeds oftentimes, gradually, into the whole Maſs of Blood, and not into the cellular Membrane, as BOERHAAVE imagined. In ſome Caſes, where the Penis has become cancerous, either from

venereal Diſeaſes, or otherwiſe, Amputation has been practiſed with Succeſs.

Ruysch has given us an Inſtance of this in his xxxth Obſervation; Warner, Caſe xxvii. of his Practical Obſervations in Surgery, has done the ſame; and I myſelf, about three Years ago, amputed the Glans of a Penis which was ſo much ſhancred that it could not be cured.

LECTURE XIV.

Of the ORGANS ſubſervient to GENERATION in FEMALES.

THE Parts of Generation, in Females, are divided into external and internal; and they are all ſubordinate to one principal called the Uterus: The other internal Parts are, the Tubæ Fallopianæ, Ovaria, Vaſa Spermatica, Ligamenta Lata, Ligamenta Rotunda, and the Vagina or Canal of the Uterus. The external Parts are, the Pubes, Alæ, Nymphæ, Clitoris, Orifice of the Urethra, and the external Entrance to the Orifice of the Uterus.

The Pubes is that broad Eminence at the inferior Part of the Hypogaſtrium, between the two Inguina, on which Hairs grow, at a certain Age; and almoſt of the ſame Kind with thoſe found under the Axillæ. This Eminence owes its Thickneſs to the Membrana Adipoſa which covers it anteriorly, and ſome ſmall Portions of the adjacent Muſcles.

The longitudinal Cavity, which reaches from the Middle and inferior Part of the Pubes, within an Inch of the Anus, was by the Antients called Sinus; and the lateral Parts of it Alæ, which is a more proper Name than that of Labia, commonly given to them. The Places where the Alæ are joined above and below, are

named Commiſſures; and may likewiſe be called the Extremities or Angles of the Sinus.

The Alæ are more prominent, and thicker ſuperiorly than below, and lie nearer each other inferiorly than ſuperiorly. They are chiefly compoſed of the Skin, cellular Subſtance, and Fat. The exterior Skin is a Continuation of that of the Pubes and Inguina. It is more or leſs even, and furniſhed with a great Number of glandular Corpuſcles, from which a whitiſh ceruminous Matter may be expreſſed; and, after a certain Age, it is likewiſe covered, in the ſame Manner, with the Pubes.

The internal Side of the Alæ is ſomewhat like the red Portion of the Lips of the Mouth; and it is diſtinguiſhed every-where from the external Side by a kind of Line, in the ſame Manner as the Lips from the reſt of the Skin; being likewiſe thinner and ſmoother than the external Skin. A great Number of Pores are obſervable in it, and alſo numerous glandular Corpuſcles which furniſh a Liquor more or leſs ſebaceous; and theſe Corpuſcles are larger near the Margins than in the other Parts.

Near the internal Margin of the inner Surfaces of the Alæ, on each Side of the Orifice of the Canal of the Uterus, we find a ſmall Aperture more viſible than the reſt: Theſe two Apertures are called Lacunæ; and they communicate, by two ſmall Ducts, with the ſame Number of follicular Bodies lying in the Subſtance of the Alæ, and may be looked upon as ſmall Proſtates anſwering to the Glandulæ Proſtaticæ in Males. When preſſed, they diſcharge a viſcid Liquor.

Above the ſuperior Commiſſure, a thin flat Ligament runs down from each ſmall Branch of the Oſſa Pubis, which penetrates the Fat in the Subſtance of each Ala, and is inſenſibly loſt therein near the Margin. Theſe may be looked upon as

the

the Ligamenta Suſpenſoria of the Alæ. The inferior Commiſſure of the Alæ is very thin, or like a membranous Ligament; and, together with the adjacent Parts of the Sides, forms a Foſſula called Navicularis, or Scaphoïdes. The Space between the inferior Commiſſure and Anus, called Perinæum, is about a Finger's Breadth in Length.

The other external Parts are ſituated in the Sinus, and hid by the Alæ. Directly under the ſuperior Commiſſure lies the Clitoris, with its Covering, called Præputium; a little lower, in the Orifice of the Urethra, is the Vagina. The Circumference of this Orifice is bordered either by a membranous Circle called Hymen, or by fleſhy Portions named Carunculæ Myrtiformes. On each Side of the Clitoris begins a very prominent Plica, like a Criſta, which runs down obliquely on each Side of the Orifice of the Urethra; theſe Plicæ are called Nymphæ, and they might likewiſe be named Criſtæ Clitoridis. On each Side of the great Orifice lies the ſmall proſtatic Lacunæ, which, in Coition, ſometimes evacuate a great Quantity of a Fluid that has been taken, by the Antients, for the Semen Fœmineum; and they are alſo the Seat of a Gonorrhæa, as the Proſtates in Men.

The Clitoris appears, at firſt Sight, like a ſmall imperforated Gland. Its ſuperior and lateral Sides are covered by a kind of Præputium formed by a particular Plica of a Portion of the internal Side of the Alæ, which appears to be glandular, to diſcharge a Mucus, and is internally granulated.

By Diſſection we diſcover, in the Clitoris, a Trunk, and two Branches, as in the Penis, formed of a ſpongy Subſtance, and very elaſtic Tunics, but without any Urethra: This Subſtance may be inflated or injected by its Artery. The Trunk is divided into two lateral Parts, by a middle Septum,

from the Bifurcation to the Glans, where it is insenſibly loſt.

The Bifurcation of the Trunk is on the Margin of the cartilaginous Curvature of the Oſſa Pubis; and the Branches, which reſemble the Roots of the Corpora Cavernoſa, are inſerted into the inferior Rami of theſe Bones, and into thoſe of the Oſſa Iſchium, where they terminate by Degrees; but there is ſometimes a membranous Tube on each Side, which reaches to the Tuberoſity of the Iſchium.

The Trunk of the Clitoris is ſuſtained by a Ligamentum Suſpenſorium fixed in the Symphyſis of the Oſſa Pubis, and ſuſtaining this Trunk, in its Duplicature, nearly as in Man.

Four Muſcles, or Faſciculi, of fleſhy Fibres are inſerted in the Trunk of the Clitoris, two on each Side. One of them runs down on the anterior Side of the adjacent Corpus Cavernoſum, and is inſerted, by a tendinous or aponeurotic Membrane, partly into the Extremity of the Corpus Cavernoſum, and partly into the Tuberoſity of the Iſchium. Theſe two Muſcles are called Erectores; but the Name of Iſchio-Cavernoſi would be moſt proper, as in Man.

The other Muſcle on each Side lies under the former, and runs down laterally to the Urethra and great Orifice of the Uterus, all the way to the Anus; increaſing gradually in Breadth in its Paſſage, and terminating partly like that which is called Accelerator in Males.

Theſe two Muſcles ſurround, very cloſely, the lateral Parts of the Urethra and the Entrance of the Vagina. They expand very much as they deſcend, and are ſpread on the inferior and lateral Parts of the great Orifice; for which Reaſon, ſeveral Anatomiſts have looked upon them as muſcular

cular Sphincters. All these four Muscles, especially the two latter, are oftentimes almost covered with Fat.

The sanguiferous Vessels of the Clitoris come chiefly from the Hypogastricæ, and the Nerves from the second and third Pairs of the Nervi Sacri, by means of which they communicate with the inferior mesenteric Plexus, and with the great Sympathetici.

The Nymphæ, Cristæ Clitoridis, or, as they may likewise be called, Alæ Minores sive Internæ, are two prominent Plicæ of the internal Skin of the great or external Alæ, reaching from the Præputium of the Clitoris to the two Sides of the great Orifice of the Uterus. They begin very narrow; and, having increased in Breadth in their Course inferiorly, they are again contracted at their Extremity.

They are of a spongy Substance, intermixed with Glands, several of which may be perceived by the naked Eye: Their Situation is oblique, their superior Extremities lying near each other, and the inferior at a much greater Distance. In married Women they are more or less flaccid and decayed.

By the Urethra, in Females, we mean the urinary Duct, the Orifice of which is between the Nymphæ below the Gland of the Clitoris. The Sides of this Orifice are a little prominent, wrinkled, and perforated by small Lacunæ, from which a viscid or mucilaginous Liquor may be squeezed. In Time of Pregnancy this Orifice is sometimes drawn a little internally.

The Substance of the Urethra is a spongy Duct of the same Structure as in Males, but much shorter, situated directly under the Trunk of the Clitoris, and above the great Canal of the Uterus, adhering to each of these Canals, between which it lies, by

membranous Filaments. It paſſes under the cartilaginous Curvature of the Oſſa Pubis, and terminates, by an oblique Opening, at the Cervix of the Bladder; being bent a little inferiorly between its two Extremities.

The internal Membrane of the Urethra is a little plaited, and perforated by ſmall Foramina, which communicate with Folliculi, lying hid in its Subſtance, as in Males. If we blow into one of theſe Foramina, we obſerve a ſmall Duct inflated, which runs from the exterior to the internal Parts, and terminates, in ſome Places, by a kind of Sacculus, on compreſſing which, a viſcid Liquor is diſcharged.

The Continuation of this Membrane, which lines the Cervix of the Bladder, forms likewiſe ſeveral Rugæ, more or leſs equal; but that which lines the Cavity of the Bladder is wrinkled in an irregular Manner when the Bladder is empty.

The great Canal, formerly called the Cervix of the Uterus, is ſituated below the Urethra, and above the Extremity of the Inteſtinum Rectum a little obliquely; being more raiſed on the internal and poſterior Part than on the external or anterior.

Its internal or poſterior Extremity joins that of the Body of the Uterus, and ſurrounds its Orifice much in the ſame Manner as the Duodenum does the Pylorus, or as the Ilium is ſurrounded by the Cæcum and Colon.

The anterior Extremity forms the great Orifice which lies under that of the Urethra, and above the Foſſula of the inferior Commiſſure of the Alæ.

The Body of the Canal is chiefly formed of a ſpongy Subſtance interwoven with numerous ſanguineous Veſſels; and it is commonly longer and narrower in Virgins, than in others.

Its

Its internal or concave Surface has ſeveral tranſverſe Rugæ, and is covered by a particular Membrane. Theſe Rugæ are formed by oblong narrow Eminences, incurvated like Portions of Arches, placed very near each other, and diſpoſed in ſuch a Manner, as to divide the Cavity of the Canal into a ſuperior and inferior Side.

By the Union of the Extremities of the ſuperior and inferior Rugæ, a kind of Raphe or Suture is formed on the right and left Sides; and both Arches are ſometimes interſected in the Middle, and ſo form two Semicurvatures; but in this there is ſome Variety.

In general theſe Curvatures are very conſiderable in young Perſons; become gradually more ſuperficial in married Women, and are quite loſt in Time of Delivery.

The internal or poſterior Extremity of this great Canal ſurrounds the Orifice of the Uterus a little obliquely, in ſuch a Manner, that the ſuperior Side of the Canal lies very near the Orifice, and the inferior at a greater Diſtance from it; and this makes the Extremity of the Uterus appear to advance more into the Canal on the inferior than on the ſuperior Part.

The external or anterior Extremity of this Canal in Virgins, and eſpecially before the firſt Eruption of the Menſes, is commonly bordered by a circular membranous Plica, of different Breadth, more or leſs ſmooth, and ſometimes ſemilunar, which, in ſome Subjects, leaves but a very ſmall Aperture, in others a larger, and in all renders the external Orifice narrower than the reſt of the Cavity. This Plica, called Hymen, is formed by the Union of the internal Membrane of the Vagina with that on the internal Side of the Alæ, and repreſents a membranous Circle of different Breadth, and ſometimes uneven.

This membranous Circle is commonly ruptured after Coition, and is quite loſt in Delivery; and afterwards only ſome irregular Portions of it remain, which, from their ſuppoſed Reſemblance to Myrtle Leaves, have been called Carunculæ Myrtiformes. This Circle may likewiſe ſuffer by too great a Flux of the Menſes, or, being thin, may be eaſily lacerated, by Laſciviouſneſs and other Accidents.

Each Side of the anterior Portion of the Vagina is covered exteriorly by a thin, broad, cavernous, and vaſcular Plexus, called the Retiformis of that Canal: Theſe two Lamellæ run down on each Side of the Clitoris behind the Nymphæ, and likewiſe cover the Urethra, like a Collar, before they are ſpread on the great Canal.

This Plexus is cloſely united to the muſcular Portions commonly taken for Accelerators or Contractors, lying between theſe Portions and the lateral Parts of the Urethra and the great Canal.

It may be inflated like a flaccid Spleen, or like the ſpongy Subſtance of the Clitoris, with which it ſeems to have ſome Communication; and, on that Account, the lateral Portions of this reticular Plexus have been named the internal Crura of the Clitoris. It is a kind of Rete Mirabile, compoſed of Veſſels which ariſe chiefly from the Hypogaſtricæ.

It ſtill remains to be obſerved, that, on each Side of the Bottom of the Pelvis, in both Sexes, oppoſite to the inferior Part of the Bladder, there is an aponeurotic or tendinous Ligament, which runs over the internal Surface of the Muſculus Obturator Internus from the anterior to the poſterior Part. The anterior Extremity of this Ligament is fixed on one Side of the middle Portion of the Symphyſis of the Oſſa Pubis, and the poſterior

ſterior to the middle Part of the Ligamentum Sacro-Sciaticum.

A little above the Elongation called the Cervix of the Bladder, there is another ligamentary Expanſion on each Side, the anterior Part of which is narrow, and fixed to the anterior Extremity of the Ligament already mentioned; and the broad poſterior Part to the Side of the Bladder: Theſe two lateral Expanſions may be looked upon as proper Ligaments of the Bladder, by which it is connected to the internal Side of both Oſſa Pubis.

To the anterior Portion of each of theſe Ligaments is fixed a particular Faſciculus of fleſhy Fibres, which aſcend obliquely on the anterior Part of the Bladder, on which thoſe of each Side meeting, form a kind of muſcular Intertexture, and unite with the moſt tranſverſe Fibres of the Bladder.

Theſe two muſcular Faſciculi form a Part, and perhaps a principal one, of what is called the Sphincter of the Bladder; but, to have a true Idea of them, they muſt be examined in Situ, without deſtroying any of their natural Connections. When the Bladder is removed out of its Place, as is done in the common Method of Diſſection, theſe Faſciculi are cut; and thereby, their Direction being changed, they appear tranſverſe, and are taken, by thoſe who know no better, for Portions of an orbicular Sphincter.

In Males theſe two Faſciculi are partly fixed in the Proſtates; but in Females they are very broad, and appear ſometimes to be double on each Side, one Lamina lying above the other. They are to be looked upon as true Muſcles, fixed by ſmall Tendons on the Sides of the Symphyſis of the Oſſa Pubis.

The

The Uterus lies between the Bladder and Inteſtinum Rectum. It is a Body internally concave, externally of a whitiſh Colour, of a pretty ſolid Conſiſtence, and, except in Time of Pregnancy, its Figure is that of a flat Flaſk; being, in Adults, about three Fingers Breadth in Length, one in Thickneſs, and two in Breadth, at one End, and ſcarcely one at the other. This Size varies according to the Age of the Subject, &c.

The broadeſt Portion is named the Fundus, and the narroweſt the Cervix. Its Situation is oblique; the Fundus being turned poſteriorly and ſuperiorly, and its Cervix anteriorly and inferiorly: The broad Sides lie next to the Rectum and Bladder, and the narrow ones are lateral.

The Cavity of the Uterus is flat, and reſembles an oblong Triangle, the ſhorteſt Side of which anſwers exactly to the Fundus, and the two longeſt Sides lie one on the right, the other on the left; and they are all bent internally, or towards the Cavity formed by them.

Of the three Angles of this Cavity, the two which terminate in the Fundus are perforated each by a narrow Duct, which with Difficulty admits a Hog's Briſtle; the third Angle forms a flat Duct wider than the former, which perforates the Cervix of the Uterus longitudinally, and terminates at its Extremity by a tranſverſe Opening.

This Opening is named the internal Orifice of the Uterus; and, in its natural State, is narrower than the Duct of the Collum Uteri, ſo that only a ſmall Stilet can be admitted. At the Margin of this Orifice are ſeveral ſmall Apertures, anſwering to the ſame Number of glandular Corpuſcles, which diſcharge a viſcid Lympha.

The internal Surface of the Cavity of the Uterus is lined with a very fine Membrane, which at the Fundus

Fundus is ſmooth and even, but in the Cervix is wrinkled in a particular Manner.

The Portion of this Membrane, which covers the Fundus of the Cavity, is perforated by a great Number of conſiderable Foramina, through which ſmall Drops of Blood may be obſerved to paſs, when the whole Uterus is compreſſed; and ſometimes it appears to have very ſmall Villi, or Hairs. Both theſe Villi and Foramina are obſerved to be more or leſs tinged with Blood, in thoſe Women who die in the Time of their Menſes.

In the narrow Part, which anſwers to the Collum, each Side is divided into two Laterals by a kind of prominent longitudinal Line, which is larger in the ſuperior or anterior Side, than in the inferior or poſterior.

On each Side of theſe two longitudinal Lines, there are others, or Rugæ, obliquely tranſverſe, diſpoſed like longitudinal Branches repreſenting Trunks; between and round theſe Rugæ there are ſmall Lacunæ, through which a mucilaginous Fluid is diſcharged, which it is ſaid in Pregnancy lutes the internal Orifice of the Uterus (which ſeems inconſiſtent; as the Cervix is a true Sphincter to the Fundus: For as the Uterus dilates, the circular Fibres of the external Orifice of the Cervix contract, till they are all extended, which is generally about the Time of Delivery; and I think every Practitioner in Midwifery muſt be ſenſible of the Truth of what I here advance). We obſerve likewiſe, in the Interſtices between the Rugæ, ſeveral tranſparent globular Corpuſcles, which a modern Author took for a kind of Ova.

The Subſtance of the Uterus is ſpongy and compact, with a copious Intertexture of Veſſels: Its Thickneſs is nearly equal and uniform in the Sides and Margins, but the Fundus is thicker towards the Middle than the two Angles, where the Thick-

neſs

neſs decreaſes gradually. The Margins are likewiſe much thinner near theſe Angles, than the Extremity of the Cervix.

The Uterus is covered by a Portion of the Peritonæum, which ſerves as a Tegument, and is a Continuation of that which covers the Bladder and Inteſtinum Rectum; running up from the inferior and poſterior Part of the Bladder over the anterior Part of the Uterus, thence over the Fundus, and down the poſterior Side, and afterwards going to the Rectum.

On each lateral Part or Margin of the Uterus this Portion of the Peritonæum forms a broad Duplicature, which is extended on each Side more or leſs, directly to the contiguous lateral Parts of the Pelvis, forming a kind of membranous Septum between the anterior and poſterior Halves of that Cavity; and is afterwards continued looſely, with the Peritonæum, on the Sides of the Pelvis.

Theſe two broad Duplicatures have the Name of Ligamenta Lata, and Veſpertilionum Alæ. The ſuperior Margin of each is partly double, or folded, forming two ſmall diſtinct Duplicatures, which WINSLOW calls the Pinions of the broad Ligaments. The anterior Pinion is more raiſed than the poſterior, and they are both very looſe.

The Laminæ of all theſe Duplicatures are connected by a cellular Subſtance, in the ſame Manner as the other Duplicatures of the Peritonæum; and they contain the Fallopian Tubes, Ovaria, Part of the ſpermatic Veſſels and of thoſe which go to the Body of the Uterus, the Ropes * called the round Ligaments, Nerves, &c.

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* Hence chiefly come thoſe Pains and Numbneſs which pregnant Women complain ſo much of in thoſe Parts, and which increaſe as the Uterus grows bigger and higher.

The

The Antients imagined that the Ligamenta Rotunda were two hollow Tubes, whereby Women emit their Semen: But as these Ligaments have not yet been demonstrated to be tubular, this Argument cannot take place. The Moderns say, they suspend the Uterus, and hinder its rising too high: How, then, can pregnant Women suffer it to ascend sometimes even into the Epigastrium? Neither are they sufficient to keep the Matrix from rolling, in convulsive Motions. In hysteric Affections the Uterus moves sometimes upwards, sometimes downwards, with so much Force and Violence, as shews that these Ligaments have but little Power over it.

From what has been said it appears, that both the Antients and Moderns understood not the true Use of these Ligaments.

However, their Actions conjointly with the Ligamenta Lata, seem to be rather intended by Nature to keep the Uterus in a proper Situation, during the Time of Pregnancy, than for any other Purpose.

They hinder the Body of the Matrix from pressing too much on its Cervix, and subsiding, or bearing down, as happens when these Ligaments are too much relaxed by difficult Births, &c. It is from these Duplicatures that Women with Child feel Pains and Lassitude in the Loins.

The Uterus is said to be oblique when it inclines either posteriorly or anteriorly to the right or left Side; that the Os Uteri, being distorted in such a Manner from its natural Direction, towards any Bone of the Pelvis, can scarcely, or not at all, be touched; and this is termed a preternatural Position or oblique Situation of the Womb; and which may happen either before or in Time of Pregnancy.

The Obliquity of the Uterus may be occasioned by many and different Causes, whereof some are

tranſitory, others permanent: Such are Spaſms, inflammatory Tumors, Dropſies, Hydatides, Ulcers, an indurate Gland, a fungous Excreſcence, Cicatrix, or the like; either in the Uterus, Ligaments, or adjacent Parts: Alſo the Weight and Bulk of its Fundus, and over-extended Ligaments in Time of Pregnancy; for we ſee how variouſly Women with Child move their Bodies, bending them every way for Relief, when afflicted with Pain; both ſitting and lying in different Poſtures; all which may eaſily give the Womb a Tendency this or that Way: Likewiſe a Strain, or Rupture, in any of theſe Ligaments, from violent Efforts, ſo that its Antagoniſt acts too forcibly. And, laſtly, from any irregular Conformation either of the Uterus, Ligaments, or Bones of the Pelvis. Hence the Obliquity of the Uterus ſometimes happens in Virgins.

It commonly hinders Conception; and, if it happens at the Time of Pregnancy, occaſions difficult and dangerous Labours.

The OVARIA are two whitiſh, oval, flat, oblong Bodies, ſituated on the Sides of the Fundus Uteri, to which they are fixed by a kind of ſhort round Ligament, and incloſed, together with it, in the Duplicature of the poſterior Pinion of the Ligamenta Lata.

They are compoſed of a compact ſpongy Subſtance, of ſeveral little tranſparent Veſiculæ, which are called Ova. The ſpongy Subſtance ſurrounds each of theſe Veſiculæ very cloſely, and ſeems likewiſe to furniſh them with diſtinct ſpongy Calices. They are to be carefully diſtinguiſhed from other preternatural ones termed Hydatides.

The Ligaments of the Ovaria lie in the Margins of the poſterior Pinions of the Ligamenta Lata, much in the ſame Manner as the umbilical Vein in the anterior or umbilical Ligament of the Liver.

Liver. They are round Ropes, of a filamentary Texture, fixed by one Extremity to the Corner of the Fundus Uteri, a little above and behind the Level of that Fundus. They were formerly believed to be concave, and looked upon as Vasa Deferentia.

The FALLOPIAN TUBES are two flaccid, conical, and vermiform Canals, situated more or less transversly on each Side of the Uterus, between the Fundus and the lateral Parts of the Pelvis, and included in the anterior Duplicatures or Pinions of the Ligamenta Lata.

Each of them is fixed, by its narrow Extremities, in the Corner of the Fundus Uteri, into which it opens, though by so narrow a Duct as hardly to admit a large Bristle: From thence their Diameter augments, by degrees, all the way to the other Extremity, where it is about one third Part of an Inch. The Body of the Tubæ goes on in a winding Course, and their large Extremity is bent towards the Ovaria.

These large Extremities are irregularly round, and terminate by a narrow Orifice, a little plaited and turned towards the Ovarium, where it presently expands in Form of a membranous Fringe, full of Plaits and Incisures. These Fringes are called the broad Ends of the Fallopian Tubes.

The Breadth of the Fringe is not equal in all Parts. Its Circumference is in a manner oval, and its longest Segment reaches to, and is fixed in, the Ovarium. The Plicæ are disposed, like Laminæ, on the concave Side.

These Tubes are composed of fleshy Fibres, some of which are longitudinal, and others obliquely circular, with an Intertexture of another very fine Substance.

The anterior Pinions of the Ligamentum Latum serve for a common or external Tunic to both Tubæ,

Tubæ, and alſo to connect them, in the ſame Manner as the Meſentery connects the Inteſtines; from thence the Tubæ, and eſpecially their Fringes, come to be looſe, and their Direction very imperfectly determined in moſt Figures.

Their Cavity is lined with a ſoft glandular Membrane, which is plaited longitudinally, almoſt like the internal Surface of the Aſpera Arteria; and theſe Folds are ſtronger and broader near the great Extremities than any-where elſe. Their Subſtance ſeems to be ſpongy, and the Interſtices between them are moiſtened, more or leſs, by a Fluid which is continually diſcharged there.

The ſanguiferous Veſſels of theſe Parts are of different Kinds; viz. the hypogaſtric Arteries and Veins, the Ramifications of which belong chiefly to the Body of the Uterus; the ſpermatic Veſſels, and the two Ligamenta Rotunda.

The hypogaſtric Branches are arterial and venal Ramifications ariſing from the Artery and Vein of the ſame Name, which, having reached the lateral Margins of the Uterus, are diſtributed to all the Parts thereof, both internal and external, forming a great Number of Incurvations and particular Intertextures.

The Arteries of one Side communicate both upon the Uterus, and through its whole Subſtance, with thoſe of the other Side, and the arterial Ramifications of each Side form numerous Anaſtomoſes with each other. The Veins communicate together, on each Side, in the ſame Manner; and all theſe ſanguineous Veſſels communicate likewiſe with the ſpermatic Veſſels, Ligamenta Lata, and Hæmorrhoïdales.

Theſe frequent Anaſtomoſes may be demonſtrated by injecting, or blowing into, the hypogaſtric Veſſels, having firſt made proper Ligatures, to prevent the Liquor or Air from running into

into other Parts. The Extremities of these Arteries terminate and open into the Cavity of the Uterus; and there is this peculiar to the Veins, that they communicate with the Hæmorrhoïdales, and consequently with the Venæ Portæ.

The spermatic Vessels have nearly the same Origin in Females as Males, and likewise the same Course and Intertextures; but they never pass out of the Abdomen, being wholly distributed to the Ovaria and Tubes, and communicate with the Hypogastrics and Ligamenta Lata. The Veins are very large in proportion to the Arteries, and these Vessels send lateral Ramifications, which seem to communicate with the Mesaraicæ and Venæ Portæ.

The Ligamenta Rotunda are two long small Fasciculi of Arteries and Veins, interwoven and connected by a fine cellular Substance, and run in the great Duplicature of the Ligamenta Lata from each Corner of the Fundus Uteri, as far as the annular Openings of the abdominal Muscles.

In this Course each Ligament thrusts externally, or raises the anterior Lamina of the Duplicature, which, consequently, gives a kind of Tunic to these vascular Fasciculi, and makes them appear like distinct Ropes connected to this anterior Side of the Duplicatures.

They seem to arise from the Communication between the Vasa Spermatica and Hypogastrica, and might be reckoned a particular Continuation of the spermatic Vessels. The Disposition of their Adhesions to the Angles of the Fundus Uteri, with respect to that of the Tubes and Ligaments of the Ovaria which lie all near each other, is thus: The Tubes lie superiorly, the Ligaments of the Ovaria posteriorly, and the Ligamenta Rotunda anteriorly, and a little lower than the former.

Afterwards they run in a Courſe nearly reſembling that of the ſpermatic Veſſels in Males, paſs the Abdomen through the Openings of the abdominal Muſcles, and are loſt in the Fat of the ſuperior and middle Parts of the Groins. (It may be conjectured, that theſe Ligaments or Veſſels furniſh the Lacunæ, of which hereafter.) As they paſs out of the Abdomen, they are accompanied by a Production of the cellular Portion of the Peritonæum, as the ſpermatic Veſſels in Males, and by a Faſciculus of fleſhy Fibres, repreſenting a kind of Cremaſter.

Beſides all the Veſſels hitherto mentioned, we obſerve Nerves and Lymphatics, to which we may add the lactiferous Ducts which are ſeen in an advanced Pregnancy. The Nerves come from the Lumbares, Sacri, and Sympathetici Maximi, the ſame as in Males. The Lymphatic Veſſels run chiefly in the Tunics continued from the Peritonæum, and alſo the particular Fibres which ſeem to be interwoven in the Subſtance of a pregnant Uterus; the interior of which being diſpoſed in a vortical or turbinated Manner, gave Occaſion to Ruysch to deſcribe them particularly by the Name of Muſculus Uteri Orbicularis.

All the lymphatic Veins of this Organ terminate in a large Gland, ſituated in the Diviſion of the iliac Veſſels. The Veſſels of the Pelvis are larger in Women than in Men.

Astruc remarks, on the Tunics or Membranes of the Uterus; that the firſt is the Peritonæum; the ſecond, or middle Tunic, is muſcular, compoſed of Fibres almoſt in omnem ſenſum like a Bottom of Thread: For ſaying that theſe Fibres are longitudinal, circular, and oblique, gives not a ſufficient Idea of their Direction. Yet I own, that the greater Part of theſe carnous Fibres are longi-

longitudinal; Nature foreſeeing their greater Uſe in the Function of this Organ, particularly for Copulation and Geſtation. The third, or internal Tunic, is nervous, and thicker than the external one. It is full of Aſperities on its convex Surface, for the cloſer Adheſion to the ſuperior Membrane; but ſmoother on the concave one, that it may the better expel the Menſes, and retain the Semen Virile. Theſe Eminences are named Glands by ſome, but I call them Colatoria Lactea, or veſicular Subſtances. That there are ſuch veſicular Subſtances*, with a great Number of other Veſſels, is evidently proved by Experiments: For if you ſufficiently macerate a Uterus, and then preſs a Portion of it, you will obſerve the gaping Orifices of theſe Veſſels eject their Contents.

That theſe Colatoria are ſimply veſicular in Sheep, and vaſcular, or only compoſed of Veſſels, in Swine; but in Women they are veſiculo-vaſcular, or compoſed of ſmall Bladders and lacteal cylindric Veſſels, at the ſame Time; the excretory Ducts of them gape into the internal or concave Surface of the Uterus. In theſe Vaſculars is ſecreted a lymphatic Matter, whilſt the Subject is young; but when ſhe comes to have her Menſes, and her Breaſts ſwell (or, as they ſay, ſore Breaſts), the Matter is chylous, or milky. In Pregnancy it is ſtill more ſo; but at the Time of Parturition it is pure Milk, as we obſerve in the Breaſts, and that in the ſame Proportion and Degree: Nay, the Glands of the Uterus, by Analogy, may be compared to thoſe of the Breaſts; the former being the Vicegerent of the latter. For the Glands of the Matrix nouriſhes the Fœtus

* This ſecreted Liquor is very profuſe in Female Infants, but afterwards gradually diminiſhes.

with their excretory Liquors, as the Breasts afterwards do the Infant with Milk.

With regard to the Distribution of the Veins, with their particular Texture in the Uterus; the uterine cylindrical Arteries still preserve this Figure, particularly at their Extremities, till, by the Accession of other capillary Vessels, their Diameters are gradually enlarged; at which Time they acquire a conic Form, and get the Name of Veins; still, by their Union and Reunion, forming larger Trunks, which are of considerable Diameters in the Uterus, in which Organ they form numerous Angles, Contortions, and Anastamoses, the Reasons whereof shall be given hereafter. Besides these, there is another remarkable Singularity observable in these Veins; viz. each Vein is divided, at its Extremity, into two Branches; one to entertain the Circulation, the other, like the Cæcum Intestinum, as a kind of Appendix to receive the menstrual Blood. These venous Appendices, especially at the Time of Conception, become so turgid, by the Quantity of Blood they receive, that they acquire a considerable Length, and are pendulous on the internal Surface of the Matrix. Besides the Assistance these Vessels lend, in the Explication of the Menses, they contribute, also, to unite the Placenta (into which they are inserted) to the Uterus. That there are such Appendices, is proved, 1. By mercurial Injections, which pass, by these Vessels, into the Uterus. 2. Because no Births happen without a plentiful Discharge of Blood, which is attributed to the Dilaceration of some of them by the Division of the Placenta, into which they are inserted. 3. These are visible, to the naked Eye, in Women who die in Child-birth, in whom they are very prominent.

The Structure of the Vagina needs no particular Explication, being so like that of the Uterus.

We

We now see, that the Substance of the Uterus is singularly composed of innumerable Vessels, and membranous and muscular Parts; which, being all most curiously interwoven, are admirably formed together in its Texture, that it might be the more capable (without Danger of breaking) to suffer the Extension which the Child and Waters cause during Gestation; to contract in Time of Labour; facilitate the Expulsion of the Fœtus and Placenta, and retract again to its natural Dimensions.

The Use of the Womb is, for the Procreation of our Species; and the Blood, which is collected in the Sinuses, is usually discharged every Month, which is called the Menses, when Women are in a healthy State, and not pregnant; as also to retain the Semen Virile, nourish the Fœtus, and preserve it till the Time of Birth.

Observations.

The Clitoris, in some Females, is so long and large, as to have been taken for a Man's Penis unperforated; whence, probably, those Females have been called, and believed to be, Hermaphrodites: But I cannot think that there is any such Thing, in the whole Lusus Naturæ, as one who has the perfect generative Parts of Male and Female.

Professor Diemerbroeck relates, that a Woman applied to him having a diseased Clitoris. She told him, that in her Youth she contracted a Custom of stimulating her Clitoris with her Finger, so as to excite Emissions, which gave her a great deal of Pleasure. Vid. Anatom. Corp. Human.

It is reported, that the Women of Asia cause their Clitorises to be burned by old Women, who make it their Practice. The Egyptians cut it before their Daughters are married.

Bellonius and Paulus Jove thought, that the Ethiopians circumcised the Clitoris.

Aetius and Eginettus direct how to perform that Operation in the eastern Countries, and perhaps at the Example of the Tribade Bassa; which occasioned Martial to write these Lines:

Commenta est dignum Thebano Ænigmate monstrum,
Hic ubi Vir non est ut sit adulterium,
Inter se geminos audet committere cunnos
Mentiturque virum prodigiosa Venus.

But Cicero, Lib. I. De Divinatione,

——— Quid cum cumis Apollo sudavit,
Capuæ victoria! Quid ortus Androgyni!
Non fatale quoddam monstrum fuit!

seems to think, that the Opinion of Hermaphrodites may perhaps have took its Rise from Jewish Rabbi's. And most of the antient Hebrews were of Opinion, that Adam was first made an Androgynus, commonly called Hermaphrodite; and that he had the Parts of both Male and Female; and that these Parts were afterwards separated: The back Part was named Eve, &c. This was occasioned by endeavouring to explain that Text of the Old Testament; "Male and Female cre-"ated he them*.—Thou hast formed me behind "and before." Or "God created Man Male "and Female," &c. Hence it is no Wonder, that this Opinion of Hermaphrodites has been so universally believed, and Laws made against them. Vid. Heideg. Histor. Patriarch. & Jus.

* ויאמר אלהים נעשה אדם בצלמנו כדמותנו וירדו כדגת הים ובעוף השמים ובבהמה ובכל הארץ ובכל הרמש הרמש על הארץ: ויברא אלהים את האדם בצלמו בצלם אלהים ברא אתו זכר ונקבה ברא אתם. Gen. i. 26, 27.

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According to this Way of explaining the Scripture, they make God to be an Androgynus; as in the Beginning of the 26th Verſe of the firſt Chapter of Geneſis.

The Exiſtence of the Hymen has been much diſputed by anatomical Authors, ſince it has been deſcribed; ſome denying that there is ſuch a Membrane: But there are many who, though they will not deny that Authors of Veracity have found this Membrane in the Entrance of the Vagina; yet ſay that it is a preternatural one, and not to be met with in very young Subjects, notwithſtanding they had neither been concerned with Man, or otherwiſe deſtroyed.

Indeed in lieu of the Hymen, or Carunales, ſometimes we find there a Membrane which cloſes the Aperture of the Vagina; but this Membrane is preternatural: We are obliged to divide it ſometimes, but very rarely.

A Girl was pronounced pregnant by the Midwives, on account of an Inflation and Tenſion of her Uterus, occaſioned by a conſiderable Quantity of menſtrual Blood retained by a ſimilar Membrane: But when an Inciſion was made, the retained Blood was diſcharged. Vid. AMBROSE PARE, Lib. XXIV.

Mr. BOUDON, ſenior Surgeon to the Hôtel Dieu of Paris, met with the like Membrane in a young Lady who was thought to have a Schirrus of the Uterus; for which ſuppoſed Diſeaſe ſhe had been a long Time under Cure; and, when well examined, was cured by an Inciſion in the Membrane which obſtructed the Diſcharge of her Menſes. We read the like in SAVIARD'S IVth Obſervation.

RUYSCH mentions a Woman, the Membrane of whoſe Hymen was intire, and very thick, which was thruſt out by the Head of the Fœtus. She

had been in Labour a long Time, and could not be delivered without dividing this Membrane by Incision. But we met with another behind it, which more deeply closed up the Passage of the Vagina, and obstructed the Exclusion of the Fœtus; wherefore he was obliged to open this Membrane also. After this last Operation, the Woman was delivered of a fine Child alive, and both did very well afterwards. Vid. Obs. XXII.

So, according to RUYSCH's Account, that Woman had two Hymens.

The Hymen, so called, appears to me to be only a Continuation of the internal Membrane of the inferior Part of the Vagina with the external one; and what are named Caruncles, or Myrtiformes, are inclosed in these Membranes. For I suspect the Caruncula not to be a Fragment of the Laceration of the Hymen (as it is commonly thought); but am apt to think they are Glands.

It does not always grow so high as the Semidiameter of the Vagina: Therefore in Women who have these Parts pretty large, they are not discernable.

In that Case of RUYSCH, here inserted, those Membranes of the Vagina certainly grew up after the Woman was impregnated, and her Husband had but a small Penis, which, when it meets with a large Vagina, may be admitted without lacerating the Hymen, especially if the Membrane is pretty strong, or low.

I have met with such small Penes, that, I dare say, they might copulate with most young Virgins without lacerating their Hymens; and I have seen the reverse in the Vaginæ of some Women, which have been smaller after Child-bearing than before, that is, more contracted.

SAVIARD gives an Account of a Woman in whom he found the left Testicle as big as a Child's Head,

Head, which he first took for a Fœtus inveſted in its Membrane; but this vaſt Volume was a Maſs of pulpous Matter hardened, with a Mixture of Seroſities; the whole weighing four Pounds.

In another Woman he found alſo one of her Teſticles about the Bigneſs of a Hen's Egg. I obſerved, on opening it, that it was cauſed by an Obſtruction of whitiſh Matter. Vid. Obſ. xcv.

I injected the whole Subſtance of the Ovary of a Woman, about twenty Years of Age, which I preſerved.

Several Ovaries (as the Moderns called them) I found diſeaſed by venereal Infections. They appeared ſomewhat like the internal Subſtance of Male Teſtes.

Dr. SAMSON gives us an Account of a Woman who died of a Dropſy of the left Ovarium. There was no extravaſated Water in the abdominal Cavity, but it was filled with a Number of Veſicles, of different Sizes, full of a viſcous Serum, ſome ſo large as to contain twenty Pounds of this Liquor, others about the Size of a Child's Head, as big as an Orange, and the reſt not larger than a Walnut. On examining theſe Veſicles, he found them to be no other than the Ovula of the left Ovarium diſtended to that monſtrous Size. He ſays, if you can imagine about forty Bladders, of different Sizes, tied together like a Reeve of Onions, you may have an Idea of this Ovarium. All the Veſicles contained about an Hundred and Twelve Pounds of Serum. Philoſophical Tranſactions, Numb. 140.

We read of a Caſe ſomewhat like it in BLANCHARD. The right Ligamentum Lata was very much diſtended by about a Hundred and Twelve Pounds of clear Water, of a ſaltiſh Taſte, and Half an Inch thick, having ſuperficially a great many aqueous Veſicles; and in the oppoſite Side another Tumor, con-

containing a purulent Matter; and several Vesicles, which weighed, at least, ten Pounds; and a third Tumor, about the Magnitude of two Fists. Vid. 2 Cant. Obs. XCVIII.

In a Woman who died of a Dropsy, her left Ovarium was swelled to a prodigious Size, so as to weigh Thirty-seven Pounds; and was divided into a great many Cysts odly complicated together. Some contained a clear Water, others a gelatinous Liquor, a Fluid like Cream, and others like Tallow. In some Parts it had a glandular, in others a fleshy Appearance. RIDLEY's Obs. Medic.

In another Woman, who died of a Dropsy, her right Ovarium was very near a Foot long, as much broad, and six Inches thick. See Medical Essays, Vol. V. Art. LXXIII.

I once met with the left Testicle of a Male distended to the Bigness of one's Wrist (I do not mean the Scrotum) with Vesicles, as in the abovementioned Cases, filled with a pellucid Lympha, which communicated with each other. Upon examining these Vesicles, they seemed to be nothing else but a Distension of the lymphatic Vessels.

LITTRE*, in dissecting a Female of two Months old, found her Vagina divided perpendicularly, by a fleshy Partition, into two equal Parts, in such a Manner, however, that the Partition was not intire, but only formed two Cavities from the Middle of the Vagina to the Uterus. Each of these Cavities terminated in a particular Uterus which had its Orifice, Cervix, and Fundus. These Sorts of Uteri, which were distinct and separate internally, had externally but one simple and continued Body, except their Bottoms, which were separated, or rather fixed to each other, only by a

* Vid. Memoires de l'Acad. des Sciences 1705; also JOANNES SCHENCK Observ. de Utero, &c.

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membranous Ligament of a triangular Figure. There were also an Ovary, Ligaments, Latum, and Rotundum. LITTRE thought, that if this Girl had lived, and conversed with a Man, she might have conceived at different Coitions, and impregnated both Uteri.

RUYSCH says, that he saw a female Child, about six Days old, who had a monstrous Conformation of the Parts of the Pudenda, which was united to the Navel, or rather with that Part of the Body which was in lieu of the Navel, the whole confused, and a Heap of excoriated Tubercles; in the inferior Part of which appeared two Foramina, from whence the Urine continually dropped, especially when the Child cried. Without doubt there was no urinary Bladder, as there was no Meatus Urinarius; and these two Foramina continued to the Ureters.

This Misconformation of Parts might perhaps arise from a Fright which the Mother received on falling from a high Place, several Weeks before her Delivery. Vid. Observ. XXIII.

The same Author relates, that a Woman, after having been a long Time afflicted with the Fluor Albus to an excessive Degree, afterwards had a Prolapsus Uteri, from the internal Orifice of which grew various Excrescencies of a ponderous Substance, partly membranous, and partly fleshy. These Excrescencies were somewhat like the Polypuses: They were very painful to the Woman, and a great Quantity of aqueous acrimonious Humour was discharged daily from the Uterus. At last, the Malignity of these Tumors killed the Patient.

Much the same Polypus Tumors were discharged, at several Times, by another Woman, and sent to me, by the Surgeon who attended her. Obs. VII.

Another

Another Woman had an Ulcer in the Uterus, attended with a continual Bleeding and insupportable Pains, which put an End to her Life. On opening her Body, the Cervix of the Uterus separated from its Body, by only touching it, as if it was intirely putrefied. The Intestines were externally united by a slight Excoriation and Inflammation, but the other Parts were sound. Ibid. Obs. XII.

I have likewise met with several ulcerated and gangrenous Uteruses: Some proceeded from venereal Infection, others from Hurt received, at the Time of Delivery, by unskilful Midwives.

RUYSCH, in his XXVIth Observation, mentions a Woman, lately delivered of a large Child, whose Uterus followed the Placenta immediately, and was inverted; whereupon an ignorant Medicaster was called in. This Fellow, instead of replacing the Uterus in its proper Situation, cut a little way into it (as he thought it was a Tumor) with the Point of a Betoury, in order to discover whether it was a preternatural Tumor filled with Matter, or the Placenta Uterina. This rash Proceeding soon killed the Patient; for a profuse * Hæmorrhage immediately ensued, which could not be suppressed by all my Endeavours.

VIEUSSENS mentions a bleaching Woman, aged Thirty Years, of a strong Constitution, who was afflicted with a Prolapsus Uteri, which fell into the Pudendum, in the Figure of a round reddish Tumor, almost as large as two Fists (which was the Uterus). As this supposed Tumor was not reductive, it was extirpated with a Ligature, and the Patient was cured.

* The Cause of this profuse Hæmorrhage was, because the Vessels of the Uterus were not contracted; nor could it be, whilst the Uterus was prolapsed.

Six

Six Years after the Patient died. On opening the Body, there was found only a ſmall Portion of the Cervix of the Uterus cicatriſed, which was very hard and callous.

AMBROSE PARE likewiſe tells us of a Woman, who, after conſiderable Vomitings, with violent Efforts, felt between her Thighs a great Weight, which was troubleſome to her. On examining the Parts, it was found to be a fleſhy Subſtance projected into the Pudendum, which could not be reduced; and as it began to be gangrenous, which determined PARE to extirpate it, in Preſence of ſeveral Phyſicians and Surgeons. Examining this Subſtance after it was amputed, it proved to be the Uterus with one of the Ovaries. Vid. Lib. XXXIV. and the like in JOAN. SCHENCK Obſerv. Lib. IV. MICHAEL ALBERT. Obſ. Med.

A Woman, after many laborious Deliveries, had a Prolapſus Uteri, which could not be reduced, but became gangrenous, and dropped off of itſelf. Vid. ROUSSETUS De Part. Cæſareſ.

A SURPRISING NUMBER OF STONES EXTRACTED BY INCISION FROM A WOMAN.

Among all the Diſorders which uſually afflict human Bodies, the Stone of the Bladder is one of the moſt grievous. Though this is very frequent with us in Holland, yet it appeared in a very extraordinary and unheard of Manner, in a Woman of Eighty Years old; who was, by reaſon of the Pain, very much emaciated; and who had been, for the Space of Twenty Years, troubled with a Prolapſus Uteri, accompanied with an intolerable Difficulty and Pain in making Water; inſomuch, that the Patient choſe much rather to die than any longer ſuffer this Torture, eſpecially during the two laſt Years.

At

At length, in the Month of May, Anno 1681, ſhe ſent for me, complaining of a Prolapſus Uteri, and Difficulty in making Water. I wondered at her Complaints, becauſe Women are never uſed to ſuffer ſuch Pains only from a Prolapſus Uteri: And I added, that it was to be feared, ſome other Diſorder, beſides the ſubſiding of the Uterus, lay, as yet, concealed.

When ſhe heard this, ſhe did not refuſe to let me ſee, and farther examine, the Parts, without which, nothing certain could be affirmed concerning the Nature or Eſſence of the latent Malady: She likewiſe ſhewed me her prolapſed Uterus.

On examining the ſaid Uterus with my Fingers, I thought I felt Stones, as indeed it happened, notwithſtanding I was miſtaken with reſpect to the Figure of them; for they ſeemed to me to be like thin flat Stones, or Pieces of Slate: Whereas after Inciſion they were found thick and angular. But as yet I could not certainly determine whether the forementioned Stones were ſeated in the Cavity of the Uterus itſelf, or whether they were lodged between its Membranes, or in ſome Part of the Bladder. They ſeemed indeed to occupy Part of the Uterus, the Whole of which, as far as could be perceived, prolapſed without being accompanied by any Part of the Bladder. Having ſeen and examined theſe Particulars, I propoſed cutting out the Stones; and Mr. PETER ADRIAN junior, with Mr. ANDREW BOCKELMAN, two very expert Surgeons, were called in. They likewiſe conſented that the Operation ſhould be performed the next Day. When the unfortunate old Woman heard that the Operation was deferred till the next Day, ſhe began to weep, and cry out, O how miſerable am I! Will you leave me without Help, or not return ſpeedily, &c.? By which,

and

and the like Complaints, being moved with Compaſſion, we inſtantly performed the Operation by a ſimple Inciſion, continued according to the Length of the prolapſed Uterus; and, by that means, we extracted, in the Space of a Minute, Forty-two Stones, partly by Inſtruments, and partly by the Fingers alone, the Magnitude and Figure of which were various.

During the Operation, the Patient did not complain much of Pain; and after it was performed, by being freed of the oppreſſive Weight, thoſe excruciating Pains vaniſhed, with which ſhe had been tortured for ſo many Years paſt; ſo that ſhe began to live with tolerable Eaſe. On making the Inciſion, a Sort of Liquor flowed from the Wound, together with Drops of Blood, from whence we ſuſpected that the Bladder was alſo at Hand, as indeed it proved: For the next Day, on making a more diligent Inquiry into this Affair, by injecting a Liquor, with a Syringe, thro' the Meatus Urinarius, we found, that it diſcharged itſelf through the Wound; which Liquor diſtilling, together with the Urine, through the Wound for ſeveral Days, made it evident, that the forementioned Stones were lodged in a Portion of the Bladder prolapſed without the Labia, in Company with the Uterus.

The continual Diſcharge of the Urine this Way, proved a great Obſtacle to us in the Cure of the Wound, which yet was completed in a ſhort Time by the following Method.

Some Days after, the Wound had been dreſſed with Linimentum Arcæi, the Lips thereof were approximated and retained very cloſely together by Emplaſtrum Diapalma, to which was added a little Turpentine, to make it ſtick the more firmly; which Plaiſter was cut into a convenient Shape, and retained with ſuitable Compreſſes, and a Bandage.

But

But as this Method did not ſufficiently anſwer our Expectation, on account of the continual dripping of Urine, and Relaxation of the ſticking Plaiſters; Mr. Bockelman contrived a leaden Ring inſtead of the Emplaſtrum, the crooked Extremities of which Ring were drawn together by a Thread; by which means the Lips of the Wound were ſo exactly cloſed, that none of the Urine was any longer diſcharged; and thus the Wound was agglutinated in the Space of three Days.

In this Diſorder there are ſeveral Things which ought to be remarked, and which are even ſurpriſing: Such as,

1. That the prolapſing Uterus ſhould take with it ſo large a Part of the Bladder, which is certainly a Thing very rarely, if ever, obſerved before, notwithſtanding theſe two Bodies, or Viſcera, are continuous together near the Os Tincæ. But I believe this to have happened, in the preſent old Woman, by reaſon of the Difficulty in her making Water, proceeding from the great Number of Stones; whence ſhe was obliged to ſtrain violently to diſcharge the Urine; by which Force, and the forementioned Coheſion of the Bladder, it could not be hindered from deſcending.

2. It is remarkable, that the prolapſing Tumor reſembled nothing but the Uterus, receiving no Inequality, nor Change in Figure, either from the Magnitude or Number of the Stones: For the Surface of the Tumor was extremely equal, the Uterus retaining its natural Figure.

3. It is ſurpriſing, that all the Stones ſhould be nearly of the ſame Figure; having their Surfaces as ſmooth as if they had been poliſhed.

4. That the Wound was very readily brought to heal, though it was inflicted upon the membranous

branous Part of the Bladder, into which the Urine is continually distilling.

5. It is to be observed, that all the Stones were not lodged in that Part of the Bladder, which, investing the Uterus above, was prolapsed, together with the same, out of the Body: For the prolapsed Part of the Bladder was not large enough in Proportion to the Magnitude and Number of the Stones; some of which, doubtless, descended, in the Operation, from the Fundus of the Bladder above.

6. That it is a Thing almost unknown, or scarce heard of, for Lithotomy to be performed, with so much Success, on a Woman so far advanced in Years. We often, indeed, hear of Stones extracted from Women by dilating the Urethra; but it is very rare that an Incision is made through the Bladder, to extract the Stone contained therein. FRED. RUYSCH's Obs.

LECTURE XV.

Of the CATAMENIA, or MENSES.

THE Deſcriptions we have hitherto given, are common to all Ages of Females; but about the thirteenth or fourteenth Year, nearly at the ſame Time when the Semen begins to form itſelf in Males, there are likewiſe conſiderable Changes produced in Females: For, at this Time, the whole Maſs of Blood begins to circulate, in a Girl, with an increaſed Force; the Breaſts are filled up, the Pubes begin to be cloathed, and at the ſame Time the Menſes, in ſome meaſure, make their Appearance. But before the menſtrual Flux, there are various Symptoms excited in the Loins; heavy Pains, Headachs, and cutaneous Puſtules, commonly ſucceed. For now the Flux of the uterine Veſſels, which, in a Fœtus State, tranſuded a ſort of lacteal Matter, and afterwards a ſerous Liquor, now begin to ſwell with Blood; which is diſtributed, in theſe Veſſels, into the Cavity of the Uterus. This continues for ſome Days, whilſt, in the mean Time, the firſt troubleſome Symptoms abate, and the uterine Veſſels, gradually contracting their Orifices, again diſtil only a little ſerous Moiſture, as before. But the ſame Efforts return again, at uncertain Intervals, in tender Virgins; till at length, by Degrees, they continue near to

the End of the fourth Week; at which Time follows a Flux of Blood, as before, which is periodically continued till between forty and fifty Years; though the Diet, Country, and Conſtitution, cauſe a great Variation in this Reſpect.

This Diſcharge of Blood, from the Veſſels of the Uterus itſelf, is demonſtrated, by Inſpection, in Women who died when they had their Menſes; and in living Women, who have an Inverſion of the Uterus, the Blood has been ſeen plainly to diſtil from the Orifices of the uterine Veſſels.

As to the Quantity of Blood evacuated at every Period of this Flux; the moſt I know is, that, in healthy Women, it is rarely leſs than eight Ounces, or more than twelve; but even this is variable, according to the Conſtitution, Age, Diet, Climate, Seaſon, Exerciſe, &c. For ſome Women diſcharge but four or five Ounces of Blood, whilſt others loſe twenty or thirty Ounces, as is obſerved in plethoric Women.

If a Woman has but little Evacuation, as when advanced in Years, ſhe becomes barren; inaſmuch as this Blood is required to nouriſh the Fœtus; and if it be too profuſe, the uterine Veſſels become thereby too lax; that is, they loſe their Elaſticity: Therefore the Matrix, in this State, is unable to conceive.

The Duration of the Menſes is very uncertain. In ſome Women it laſts three, four, or five Days only; nay, but twenty-four Hours; yet in others this Evacuation continues for ſeven or eight Days. The moſt uſual and natural Duration is, between three and five Days; and that flowing by Degrees, without Intermiſſion, and not all at once; for great and ſudden Evacuations cauſe a great Diſſipation of the Spirits.

Another Variety obſervable in the Courſe of this Flux is, that ſome Women have it more abundantly in the Night-time, by means of the Heat of the Bed, and the Rarefaction of the Blood; whilſt others are ſubject to a more copious Evacuation in the Day-time: All which chiefly depends on the Spiſſitude or Tenuity of the Blood, and the Relaxation of the Orifices of the uterine Veſſels.

If the Moon has any Influence on this Diſcharge, as ſeveral eminent Authors have advanced, I think all Women in the ſame Climate, and of the ſame Age and Conſtitution, would have their Menſes at the ſame Time and Seaſon; but it is quite otherwiſe.

The Antients imagined the Menſes to be ſo venomous and malignant, as to be ranked among Poiſons. That they withered Flowers, marred Liquors, tarniſhed Looking-glaſſes, with ſeveral other ſurpriſing Effects affirmed by them. But the repeated Experiments of the Moderns, on this Subject, have convinced us of the contrary of that Opinion; it being found that the menſtrual Blood, in healthy Women, has no ill Quality in its own Nature, but is as good as any of the whole Maſs, if not tainted and corrupted by its long Continuance in the Sinuſes of the Uterus, or by its Heat, or Mixture with ſome infected Lympha.

Sometimes the Menſes are more like Serum than Blood; which is oftener the Caſe in young Women than thoſe advanced in Years.

Moſt Authors agree, that the menſtrual Blood is diſcharged from Veins (or, more properly ſpeaking, from the uterine Sinuſes), as its Stillicidium ſeems to argue; alſo on account of its dark Colour, which is not ſo in the arterial Blood.

The Structure of the Uterus evinces, that this Blood is diſcharged by the ſame Veſſels; viz. the venous Appendices which convey the Humours

to

to the Placenta; but Reaſon and Experiments demonſtrate that theſe are Veins. The Effuſion of Blood, in Menſtruation, is not cauſed by the Rupture of thoſe venous Appendices, or Venæ Cæcæ; but rather by the Extenſion of their Extremities: Nor are they lacerated; but we may ſafely conclude that they have natural Apertures.

Theſe Apertures are not procured in the cylindric Extremities of the Arteries; for theſe degenerate into their correſponding Veins: So that the Blood, by this kind of Anaſtamoſis, is continued, by an uninterrupted Courſe, from one into the other. Whence we may conclude, once more, that it is diſcharged by the aboveſaid lateral Appendices.

The menſtrual Blood is principally diſcharged from the uterine Veſſels, as the Relaxation of the Os Uteri, and the ſtigmatic or red Spots, &c. obſervable in the Uteri of thoſe Women who have died during their Evacuations, are a ſufficient Proof of it. Moreover, in the Hydrops Uteri, &c. wherein the Os Uteri is incloſed, Women have little or no Menſtrua; nevertheleſs, ſeveral Obſervations aſſure us, that, in the above Caſes, the Vagina has ſometimes afforded very conſiderable Menſtrua, as we alſo obſerve in Pregnancy. Nor is this to be wondered at, ſince the Structure of the Vagina is ſomewhat like that of the Uterus.

Thus we ſuppoſe that there is a preternatural Plethora or Plenitude in the uterine Veſſels, otherwiſe it would be inconceivable how the Blood could expand and open the ſaid Appendices: Moreover, this Infarction of the uterine Veſſels is proved by various Symptoms of the menſtrual Evacuation; as Weight and Pains in the Hypogaſtrium and Region of the Kidneys, Heat of the Urine, &c. This particular Plethora is more

or leſs intenſe, according to the general Quantity of the whole Maſs of Blood; yet, though we extract double the Quantity of the menſtrual Diſcharge from the whole Maſs of Blood, by Veneſection; it will not be ſo wholſome, nor check the Violence of the Symptoms ſo well as the ordinary Quantity by the uterine Veſſels.

Add to this, that there are ſome reduced, impoveriſhed Conſtitutions, which have regular Evacuations, yet have no general Plethora. All which, I think, evidently proves the Neceſſity of a regular one.

But whether this particular Plenitude is formed by the Structure of the Veins, their Anaſtomoſes, &c. as Dr. FREIND * imagined, I am not ſure: For theſe cannot obſtruct the Circulation of the Blood in the Uterus, nor collect a ſufficient Quantity at the ſtated Times of Menſtruation. So that we are to ſeek for ſome more evident Cauſe, which Dr. ASTRUC derives from the Compreſſion of the uterine Veins by the periodical Diſtenſion of the Colatoria Lactea of the Matrix; which neceſſarily lean on the yielding Veins within their Reach; and the Veins, being once diſtended, compreſs the Colatoria in their Turn. To this add, that the Heat of the Blood, in the diſtended Veins, rarefies and diſſolves the lacteal Liquor of the Colatoria, whereby it becomes more fluid.

Thus Women, at the Approach of their Menſes, commonly have their private Parts bathed with a lymphatic or thin lacteal Liquor, for three or four Days before the ſanguineous Evacuation.

This chylous Flux ſometimes only attends and ſtreaks the ſanguineous Veſſels; nay, it frequently follows it only. Thus the uterine Colatoria and Appendices mutually compreſs each other, till

* Vid. his Emmenologia.

they

they exonerate themſelves of their ſuperfluous Contents.

The Site of the Uterus, the Defect of Valves in the Veins, the Want of the muſcular Action to promote the Circulation, and the lateral Preſſure of the incumbent Fluid, may alſo contribute to this Diſcharge: Thus we ſee that the Uterus, with reſpect to all the other Viſcera, is, by far, the moſt proper and beſt contrived for the Evacuation of the Menſes.

Theſe are ſimple and undoubted Principles, which yet are not more true, than eaſy to be underſtood.

Some Authors ſay, that no Animal is ſubject to the Catamenia but Women and Apes; yet we may juſtly affirm, that all other Animals are; particularly Bitches, when proud; nay, all other Animals, when in that State: Which, I own, does not happen ſo frequently, or regularly, as in Women or Apes; becauſe they do not conceive ſo often as the latter.

Of the Diseases which the Female Organs of Generation are incident to, except Venereal Infections.

The Diſorder, called by the Moderns Fluor Albus, not from the Word Flos, as ſome would have it, is very common among Women. It conſiſts in an Efflux of a whitiſh, lymphatic, ſerous, or aqueous Matter, from the Uterus.

We are to obſerve, that the Colatoria Lactea, diſtended with their Contents, compreſs the Veins; theſe, once dilated, compreſs, in their Turn, the Colatoria, which, in the preſent Caſe, yield ſo far, as to diſcharge their Fluids by the Orifices of the Veſiculæ Lacteæ. But it may be aſked, Why it does not paſs this Way, as it comes from the lacteal Fluids? The ſame Thing may be demanded with reſpect to the Milk of the Breaſts, when ſup-

preſſed. As to the latter, it is diluted, and, as it were, embalmed by the Lymph in the mammillary Veſſels; whence, being ſufficiently fluid, it is carried off by the axillary Glands, and thence into the Blood. The very ſame Thing happens in the ſaid Caſe. The Uterina Lactea being carried from the Matrix too largely, in the Bifurcation of the iliac Veſſels, thence into other Glands near the Kidneys, &c.

But if the lacteal Matter be too ſpiſſid to paſs through the ſmall Veſſels, it will ſettle in the Veſiculæ Lacteæ, which it obſtructs, or forces at length.

The firſt Cauſe is, the too great Plenitude of the uterine Colatoria. For what is more natural than that this Humour, thus collected, ſhould have the above Effects?

Let us ſuppoſe as much in ten as in twenty-ſeven Days ſhould at laſt overcome the Reſiſtance of its Veſſels; the Redundancy of the Humour is obſervable in Women who live well, have little Exerciſe, and lead a ſedentary Life; whilſt we ſee Perſons of a different Regimen, and Manner of Living, ſuch as Country People, &c. are rarely ſubject to this Diſorder.

Women thus affected, have ſometimes a ſmall Quantity of their Menſes; in ten Days afterwards, a Fluor Albus appears, and ſo on alternately.

2. A preternatural Tenuity, or ſerous Diatheſis of the uterine Lacteæ, having almoſt loſt its Colour, paſſes and ſlides ſo eaſily by the Orifices of its Veſſels, that they cannot put a Stop to it, tho' they be well conditioned. This, I ſay, ſprings from the Retention of a ſerous excrementitious Humour; as Urine, Tranſpiration, &c. Or from a conſtant Drinking of mineral Waters, Paſſions, Watchings, Exerciſe, &c. Or from ſlow Fevers, or other preceding chronic Diſorders; or too great

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an Attenuation of the Blood by Aperitives, as we ſee frequently by the Remedies given in a Suppreſſion of the Menſtrua.

If this Humour be very fluid, the Flux is continual; if only in a moderate Degree, it is periodical. In the former Caſe, the Menſtrua are little or no way diminiſhed; but, in this, they are conſiderable. The Importance of this Reflection will be explained hereafter.

3. The Relaxation of the Orifices of the Veſiculæ is frequently the Effect of a vicious Conformation, as may be ſeen from the Patient's Temperament and lax Texture of Body. It may alſo proceed from frequent Pregnancies, which attract a great Quantity of Humours to the Uterus, whereby theſe Veſſels are relaxed, eſpecially if the Blood be very ſerous.

Laſtly, This may proceed from the Diſſolution of obſtinate Obſtructions of the Uterus. For the exceſſive Diſtenſion of the Solids, during theſe Obſtructions, relaxes them ſo much, that, after the Cure, a Fluor Albus frequently follows. To theſe add the too frequent Uſe of the venereal Action.

As to the third Species of the Fluor Albus, or the lymphatic one; this is owing to the Tranſudation of the Lymph through the tender and dilated Tunics of its Veſſels, as we ſee in an Aſcites, and other Kinds of Dropſies; which cannot happen without ſome kind of Compreſſion, to put a Stop to the Circulation of the Lymph: So that, in lieu of a direct Circulation, it gets a lateral one. This Compreſſion proceeds from the Obſtructions of ſome of the larger uterine Glands, particularly that in the Bifurcation of the iliac Veſſels; or it may ariſe from the Scirrhus of the Colatoria Lac-

* The ſecond Cauſe, or Tenuity of the Humour, is rarely without Acrimony; which Remark is of Moment in the Cure.

tea,

tea, or the Relaxation of ſome Part of the Uterus. The above Obſtructions feequently proceed from a ſcorbutic, ſcrophulous, or verotic Virus; nor is any Thing more common, than to ſee alſo a fluor Lymphatic from the Obſtruction, &c. of the abdominal Glands. The Obſtructions, Tubercles, Ganglions, &c. of the very Glands and Subſtance of the Matrix, though theſe Veſſels are very ſmall, may, nevertheleſs, produce this Diſeaſe. As the above Relaxation of a Part of the Uterus gives Occaſion to the varicoſe Dilatation of the lymphatic Veſſels; whence the Lymph eaſily tranſudes; or they may be weakened through Corroſion or Exulceration, whereby the ſame Effect follows.

1. We are to obſerve, that a pure or ſimple Fluor, whether lacteal or lymphatic, is very rare: So that one Day it is more lacteal, another more lymphatical. For their Cauſes have ſuch Analogy to each other, that ſometimes they combine both, ſometimes all three, together; rarely one alone is met with: So that the Variety is infinite.

2. Some Women have a regular and periodical Fluor Albus in lieu of a ſanguineous Menſtruation, through the great Quantity of Urine they make; the Sanguification thereof bearing no Proportion to it. Moreover, the conſtant Plenitude of the Colatoria Lactea hinders that of the ſanguineous Veins. Likewiſe we may obſerve, in general, that the more the Fluor Albus is augmented, the ſanguine Evacuation is diminiſhed, and è contrario.

Of the different Kinds of Fluor Albus.

The firſt is from the ſimple Plenitude of the Uterina Lactea; the ſecond from that and a Mixture of Lymph: So the Cauſes of both are combined. The third proceeds from Tranſudation of the Lactea alone. We obſerve, that the ſecond may

may be more or leſs abundant of ſerous or lymphatic Matter of different Colours; as yellow, browniſh, green, or blackiſh: All which may be owing to the Mixture and various Colour of the Bile; or, as I am inclined to think, they may proceed from the Mixture of the Blood, if a Vein be corroded or lacerated, as to make the different Colour of Saliva.

Thus a ſmall Quantity of Blood will render the Fluor yellow; and a little more will make it of a brown Colour. This Fluor may be very acrid and cauſtic, ſo as to excoriate the Vulva. The Fluor Lymphatic is commonly of the firſt Kind, though ſometimes more or leſs in Quantity, according to the Diet of the Perſon; yet it ſeldom quite ceaſes, as it ſuppoſes a permanent Vice; whilſt the lacteal Fluor is generally periodical, being the Effect only of ſimple Plenitude; yet it may be more or leſs augmented, according, alſo, to the Perſon's way of Living, &c.

The Diagnoſtics of the Fluor Albus are theſe. 1. It can hardly be confounded with any other Diſorder but a purulent Effuſion from an Ulcer of the Uterus, or a Gonorrhæa; yet the ſenſible Difference between Pus and the Fluor Albus, renders the Diſtinction eaſy. By Inſpection, or Odour, which is always ſomewhat fœtid, and rarely to be met with in the Fluor Albus. The Inflammation, Pain, Heat, Fever, &c. which preceded the Suppuration, and which never proceed from or attend the Fluor Albus, if not inveterate, are alſo Augmentations of the Pus. Finally, The Quantity of the Fluor Albus is much more conſiderable than that of the Pus, which diſtils but by ſmall and few Drops; but if the Pus and Fluor be combined, the Caſe is ſtill more difficult: Yet Attention and frequent Examination may diſtinguiſh it: The particular Qualities we ſhall conſider, in Diſ-

orders

orders of the Breaſt. To theſe add, that, in Ulcers of the Uterus, there is now and then acute Pains, and the Patient cannot bear Coition; but the contrary in the Fluor Albus.

2. It is extremely difficult to diſtinguiſh the Fluor Albus from an inveterate Gonorrhæa, tho' proper Attention, and a competent Knowledge of each Diſeaſe, will demonſtrate them, when recent. The incipient Clap is attended with a Phlogoſis of the external Genitals, Dyſenteria, painful Copulation, Heat, and Irritation of Urine. The Pain and Phlogoſis are moſtly obſervable in the Lacunæ about the Clitoris; but all theſe Symptoms are never met with in a Fluor Albus. Moreover, this Fluor augments by Degrees; and the Gonorrhæa comes to its Height ſuddenly: But if the Clap is inveterate, all or moſt of the Accidents vaniſh; whereby it approaches nearer to the Nature of a Fluor Albus; ſo that a Phyſician may thereby be the eaſier deceived, if the Patient be not very careful to give an exact Account of the Beginning of the Diſeaſe; for thereby you may judge whether it is an inveterate Clap, or no. But the ſureſt Way to know is, by inſpecting the Parts carefully, to examine the Lacunæ particularly, and Emiſſaries of Cowper's Glands, which, if they ouze out a purulent Matter, the Infection is a Gonorrhæa, which may be alſo ſeated in the vaginal Glands. We are alſo to obſerve, that, in the Fluor Albus, the Orifice of the Uterus is generally lax and mollified; but, on the contrary, in a Gonorrhæa the Symptoms of the Fluor Albus are, 1. A Pain and Weight in the Region of the Loins, which are leſs permanent and ſenſible in the Fluor Albus, Lacteus, and Semilacteus, than in the lymphatic Fluor; becauſe the laſt is accompanied with an œdematous Swelling and Diſtenſion of the Uterus.

2. Tur-

2. Turbid Urine, which is owing to the Mixture of the Humour diſcharged by the Vagina with the Urine, as we ſee in Menſtruation; wherein ſome of the Blood is mixed with the Urine, tho' ſome ignorant Practitioners imagine, that the Urine has otherwiſe acquired this Colour.

3. Theſe Women are commonly barren; becauſe the interior Surface of the Matrix is infarcted with a lacteous or gelatinous Matter, which prevents the Tranſudation of the Semen; or they are expoſed to Abortion, whether they be impregnated before or after, as the Texture of the Uterus is made lax by the continual Efflux of Humours, which hinders the firm Adheſion of the Placenta to the Matrix. They are alſo ſubject to Diſtaſte and Longings, like pregnant Women: For the Fluor Albus draining away the digeſtive Matter, the Remainder being vitiated, they connect, and excite the uſual Senſations in the Stomach, &c.

From Indigeſtions proceed the Spiſſitude and Crudity of the Blood; whence ariſe various Obſtructions and œdematous Tumors of the Feet by Day, and of the Face by Night, through the different Situations. Therefore, in this State, the Blood is ſo impoveriſhed, that a Maraſmus ſupervenes, the Quantity of Spirits is diminiſhed, muſcular Motion, particularly that of the Heart, weakened, and the Propulſion of the Fluids begins to languiſh; to which add, the Attenuation of the Blood by a ſlow Fever, from the Retention of the excrementitious Subſtances, want of Nutrition, &c. all which concur to produce a Coldneſs of the Extremities, difficult Reſpiration, frequent but weak Contractions of the Heart, Palpitations, Syncope, &c.

Sometimes a total or partial Uteri Procedentia happens through the Relaxation of the urinary Ligaments.

If

If the Fluids of the Fluor Albus be acrid and corroſive, it exulcerates the Vulva, creates a Phlyctaneæ, &c. which generally happens, if there be a Scirrhus or cancerous Ulcer in the Matrix, from a Virus, Variolicum, or the like.

The Thinneſs and acrimonious State of the Blood, the ſlow Fever which generally is preſent, or in an inveterate Fluor Albus, with the various Obſtructions already mentioned, produce Dropſies of different Sorts at the Parts, and ſometimes Hydatides, very large, and containing ſeveral Pints of Serum; till, at length, the Patient dies dropſical, or conſumptive.

In general the Fluor Albus is very incommodious, which renders Women diſagreeable to Men. All that we have obſerved make this Diſeaſe very troubleſome and tedious, and alſo difficult to cure; nay, mortal ſometimes, if it be that Species of lymphatic Fluor Albus which creates Ulcers, Cancers, &c.

The Procedentia, Prolapſus, Deſcenſus, &c. Uteri, is a very common Diſorder. The Uterus, in this Caſe, preſents itſelf in the Vagina, between the Labia Pudendorum, or is internally prominent, and viſible without the Vulva. The vaginal Membrane may have theſe different Degrees of a Prolapſus, as its thin corrugated Texture proves, when viſible. Sometimes it is the Subſtance of the Uterus which appears ſo. Hence there are two Sorts of Procedentia to be obſerved in this Caſe; one of the Vagina, the other of the Uterus. That Part of the Vagina which prolapſes, is only a Duplicature commonly of one Part of its internal Membrane; as for the Matrix, though its Subſtance thus appears, it is never inverted, as ſome Authors imagine. Dr. Astruc's Diſeaſes of the Uterus.

A Portion of the Vagina prolapſes through its Relaxation and Diſtenſion, as the Anus of Children through its Laxity. The Cauſes of this Relaxation are by difficult Labours, or the Situation of the Fœtus in Utero, its large Size, &c. or ſometimes through the violent Introduction of the Midwife's Hand, or Forceps, before the Os Uteri is ſufficiently dilated, or the Child left too long in the Paſſage of the Uterus and Vagina. Thus the external Tunic of one is diſtended, relaxed, and, as it were, gathered into Plicæ; whilſt the internal or muſcular one contracts itſelf: Hence they are by degrees lengthened, and advanced to the Vulva. The ſame Thing may proceed from an habitual Fluor Albus, either from the Uterus, or Vagina, which perpetually bathe theſe Parts, and hence relax them; therefore we rarely obſerve an inveterate Fluor Albus without a Procedentia Uteri: And an Anus Deſcenſus likewiſe happens in Conſequence of habitual Diarrhæas, or the Relaxation of the muſcular Fibres.

The Uterus prolapſes, yet is never inverted, as ſome Authors imagine. Is it probable, that this compact Organ ſhould be ſo relaxed as to paſs through its Orifice, in Inverſion, as ſeveral Authors would have it?

There is ſometimes a Polypus in the Vagina, which often deceives one. ASTRUC relates a Tumor, which weighed five Pounds, taken off by a Ligature from a Lady about fifty Years old, who had had ſeveral Children, and afterwards had an habitual Fluor Albus. This Tumor, I own, had ſo great a Reſemblance of the Uterus, that it might have impoſed on a great many for the Matrix: Which ſhews how cautious we ought to be in examining well any Part, before we give an Opinion.

The Uteri Prolapſus is rarely dangerous; for Women bear it a long Time. I have ſeen ſome who

who were afflicted with it for thirty Years. It muſt be very diſagreeable and incommodious, not only to the Patient, but alſo to thoſe who cohabit with her; or it may be dangerous, by the Inflammation, Scirrhus, Carcinoma, &c. which it induces.

But if it be ſlight, incomplete, and without any permanent Vice, in a young Woman, &c. it is the more ſupportable: On the contrary, if it be large, inveterate, inflamed, ſcirrhous, or carcinomatous, in an old Subject, &c. it is extremely troubleſome and dangerous.

The Ovaria and Tubæ Fallopianæ are ſubject to moſt of the Diſorders incident to the Uterus. Both are ſometimes affected at the ſame Time; but the Ovaria and Tubæ Fallopianæ are frequently diſeaſed alone, and independent of the Diſeaſes of the Matrix. In the Ovaria are ſometimes obſervable hairy Tumors, whoſe Explication has puzzled the Brains of many. Theſe, I think, are nothing elſe but abortive Conceptions, which form a kind of ſteatomatous Tumor, being, as I ſuppoſe, an Embrio putrefied therein: Sometimes the Tubæ Fallopianæ, being relaxed, may drop into it.

Various Diſorders happen to Women in Conſequence of the Retention of their ſeminal Fluids in Coition and Erythiſmus: Hence ariſe Dropſies, ſteatomatous Tumors, &c. of the Ovaria, as in the Male Teſtes; whence happen a Spermatocele and Schirrus of thoſe Organs.

Dr. Astruc is ſaid to have been preſent at opening a Subject who had one of the Tubæ Fallopianæ ſo much diſtended with Serum, that moſt of the Inſpectors imagined it to be a ſecond Uterus.

As to the Cure of this Diſeaſe; theſe Organs are to be treated in the ſame Manner as Inflam-

mations of the Parts affected, frequent Bleeding, Diluents, &c. or, like cold Tumors, with Aperitives, Purgatives, &c. as the Abſceſs; which, of theſe Organs, is ſometimes happily evacuated by the Effort of Nature itſelf; but, if the Pus remains in the Abdomen, the Effects frequently prove mortal.

OBSERVATIONS.

The cutaneous Labia, riſing in two Ridges, were ſtretched in ſuch a Manner, as for the true Vulva to contain likewiſe the Anus, and terminated a little above it: The Nymphæ were very large, meaſuring one Half of the Length of the Vulva; and between them and the Labia was the Foſſa Navicularis, larger than uſual. By the Furcula, the Hymen, the proper Orifice of the Vulva, and the other Parts belonging to it, did not at all deviate from their common Structure. HALLER's Patholog. Obſerv. LXI.

The ſame Author relates, that a young Lady had a double Vagina, and a Uterus on the right and left Sides of the Pelvis, both intire, and of an oval Figure; but there was only one Ovarium to each, as alſo one ſpermatic Veſſel, with a Cervix and Valves diſpoſed into Branches, all in the natural Situation.

Each Uterus had its diſtinct Vagina: The anterior continued to the right Uterus, and the poſterior a little below its Orifice opening into the left by a ſmall Orifice not above a Line broad: Theſe two Vaginæ were parallel to each other; but there was only one Kidney. Ibid. Obſerv. LX.

In another he found the Ovarium ſo tumified, that, at firſt, he thought the Subject was pregnant; but, on examining the Part, the Uterus was found in its proper Situation, only contiguous to the ſuperior Part of the Pelvis; where two Tumors appeared ſeparated from one another by a ſmall intermediate Cavity. Ibid. Obſ. XLII.

LECTURE XVI.

Of the various Opinions, both of the Antients and Moderns, concerning the GENERATION of the HUMAN SPECIES.

OF all Physiological Inquiries, none, perhaps, discover so much Sagacity as those concerning the Nature of the Generation of the Human Species.

The Testes are those wonderful Organs by which is formed that generative Fluid which has been, and is, the Occasion of Procreation of Animals.

The Pressure of their Tunics, the Elasticity of the Fibres, and the Pulsation of the Arteries, propel the Fluid through the Corpus Highmori Canalium.

How does the Semen, which is filtrated, contribute to form Man? Is it an occasional Cause, by which the Supreme Being is determined to form the Embryo? Is it a Substance in which Ideas are inclosed, or plastic Nature, which gives it different Configurations? Is it a simple Fluid which contains Animalculæ intirely formed, or only unfolded? All these Opinions, though chimerical, have their Assertors.

If I may be allowed to say something in so great an Obscurity, the first Opinion, I believe, cannot be

be defended. If the Author of Nature ſought but an occaſional Cauſe, was it neceſſary to make ſo great an Apparatus for a Fluid? It is true, this Difficulty is eaſily anſwered. It may be alledged, that this Apparatus is only to give a Perfection to the Semen, of which it had need afterwards to produce certain Effects in the Body which are peculiar to Men. What we may here ſay is, that perhaps it may be ſo; but it is not probable. The firſt View which the Author of Nature ſeems to have propoſed in forming the ſeminary Canals, is, for the Generation of our Species.

The ſecond Opinion has been defended by many Philoſophers: There are Phænomena which ſeem to prove that plaſtic Nature is diſperſed in Matter, to give it divers Configurations. Plants partake of it: When one Branch is cut, there ariſes another. But what proves the Exiſtence of plaſtic Nature in moſt Animals, is, the Cray-fiſh: For if one of its Claws be cut, another is produced in its Place, as the Branch of a Tree. Let a Joint be cut off, or that which is above it, it all riſes again in the ſame Order. Theſe are wonderful Productions! That which is under a Joint is ſeparated from that which is above, and is only united to it by Ligaments. It does not ſeem that one is a Production of the other. Beſides, there are Muſcles inſerted from the two Extremities, in the Parts which are below the Inciſion. We cannot ſay that this is only an unfolding: Many Parts cannot be reputed the ſame, before their Expanſion; but it ſhould be in the ſame Manner as if there were an Unfolding, if the new Claw, which grows again in the Cray-fiſh, ariſes from the ſame Part, and performs the ſame Functions.

The third Opinion cannot ſubſiſt, if the firſt be true; unleſs they will affirm, that the plaſtic Na-

ture forms even Seed, the Rudiments of the Embryo: But we cannot say that those Animalculæ, discovered in the Semen, can be Man in Miniature.

1. It is certain, that there are Animalculæ found in all the Fluids of the human Body. 2. In the Liquor which Women emit in Coition, are contained Animalculæ, as well as in those of Men. 3. Supposing all this not to be so, there could be no sufficient Reasons given to conclude that it is so: For when the Parts of these Animals were to be extended, the Progress of the unfolding would not be as those which we shall take Notice of in the Embryo, where nothing is less observable than an Animal intirely formed. This Opinion was at first received.

1. That there have been Animalculæ discovered moving in Semen. 2. LEWENHOECK has extended his Discoveries through a Microscope so far, that he pretended to have distinguished the Sexes in these Animalculæ. 3. It has been observed, that they are not found in those who are much addicted to Venery. This agrees with Experience; which teaches us, that those which are given to Women, seldom propagate. 4. It has also been observed, that the Animalculæ, which are in the Semen of young Persons, are more vigorous than those of old ones, who die immediately after Emission. This may be the Reason why old People are not prolific.

Several Hypotheses have been built on this Principle.

Some were of Opinion, that the Semen, being injected into the Matrix, these Animalculæ devour each other; and that the last, which was nourished by all the others, formed the Embryo. Others think, 1. That these Animalculæ entered the Ovarium through the Fallopian Tubes; then

crawled on the firſt ripe Ovum they met with, which they entered through the Aperture, where there is a Valve to prevent their Return: And as many are ripe as there are Embryos; becauſe ſo many Animalculæ introduced themſelves therein.

It is evident, that this Deſcription is the mere Production of Imagination, which is very ill founded.

Monſters certainly ſpring from two different Species; partaking of both. Some have the Head of one Species, and the Body of another; others have the Feet of one, and the Jaw-bones of another, &c. In order that this may agree with the Syſtem of Animalculæ, theſe Monſters ſhould be formed in the Animalculæ which are diſperſed in the Semen: But it is in our Power to compute Animals of different Species; every Time they copulate, will ingender Animals of two different Kinds. Would it be poſſible that a little Monſter ſhould be inſtantly found in all theſe Copulations? Beſides, it cannot be denied, that the Ideas do not always modify Matter. The Marks which appear in Infants, whoſe Mothers have had a ſtrong Deſire after ſomething, commonly called Longings; the odd Figures with which Fœtuſes have been marked, according to the Imaginations of the Mother; all theſe prove the Action of the Ideas. If this be ſo, the Opinion which imputes the Generation of Animals to Animalculæ, cannot, I think, take Place. For, according to the Objects ſtriking the Imagination, there are found in the Fœtus Parts organized, whoſe Rudiments were not in theſe Animalculæ.

This being granted, we may conclude the Exiſtence of plaſtic Nature. TANTÆ MOLIS ERAT MORTALEM CONDERE GENTEM. See Phyſical Eſſays.

In regard to Animalculæ, they are now diſcovered even in clear Water; an Account of which we have in the Philoſophical Tranſactions.

According to PLATO, Man is the only Image of the creating Power; and the Eſſence of all Generation conſiſts in the Unity of Harmony in theſe three; viz. the Subject which procreates that in which Generation is performed, and that which is produced.

To caſt a ſtronger Light upon thoſe ſublime Notions, he adds, that the Succeſſion of Individuals is a fugitive Image of the immutable Eternity of triangular Harmony; which Doctrine has been much venerated by the Antients.

But if ever he had any Conception at all of Generation, it probably was either very confuſed, or elſe he choſe rather to make it a Myſtery to us.

The Ideas of ARISTOTLE (in his Book of Generation) do not loſe themſelves after the ſame Manner in immutable Eternity. He confines himſelf ſimply to Matter, which will have it that the Fœtus is formed, enveloped, and nouriſhed, by the menſtrual Blood of the Mother, after the Mixture of thoſe Menſtrua with the ſeminal Fluid of the Male, which acts as the Cauſe or Principle of generative Motion.

That the human Fœtus is nouriſhed by this Liquor, is beyond Diſpute; but its being originally formed from it, is an Opinion intirely exploded, ſince the Time of ARISTOTLE. Beſides, all Females of Animals have not a menſtrual Diſcharge.

HIPPOCRATES, to prevent Jealouſy between the two Sexes, has artfully inſinuated, that commonly they both concur to Generation; and thence infers, that the ſeminal Fluids, from the Male and Female,

Female, are both prolific; and that each of them consists of two different Particles; one strong and active, the other weak and sluggish: That the stronger, being united, produced the Male; and the weaker, the Female. So that, probably, the stronger, being mixed with the weaker, produced the Hermaphrodite.

DES CARTES attributes the Formation of the Fœtus to neither of those two Seeds, but to the Fermentation of both, when mixed.

FABRICIUS AB AQUAPENDENTE is perhaps the first who has observed the Fecundation and Developement of Hens Eggs; and the Result of his Inquiries was, that the glandulous Cords, which run across the White, to join with the Yolk of the Egg, being fecundated by the seminal Spirit of the Male, are the Instruments which serve to the Production of the Fœtus.

ALDROVANDE, upon Generation, is almost an ARISTOTELIAN. See his Ornithologia.

PARISANUS says, that the Seed of the Cock, or at least that white Point which is in the Middle of the Cicatricula of the Egg, is the Substance which produces the Chicken. This was advancing towards it. But had he said that this Substance was the Chicken itself, he would, perhaps, have come nearer to the Truth.

OF THE OVIPARISTS.

In Matters of Physic, general Systems are readily received, but no true one has yet appeared. From the Discoveries made upon Eggs, the Generation of viviparous Animals has been deduced.

STENO, to that End, supposed Ovaria in them; whence he was looked upon as the Chief of the Oviparists.

GRAAF has presumed to appropriate to himself this Discovery; but without entering into any Discussion of this Point: At least it follows, from their Contest, that GRAAF supposed, with STENO, Ovaria in viviparous Animals.

HARVEY also allows Ova in all Females; making no other Distinction between the oviparous and viviparous Animals than the different Manner after which the Fœtuses of either are nourished, and receive their Growth. The Generation of those Ova, according to this Author, is the Performance of the Matrix, which conceives only by a kind of Fermentation, communicated to it by the seminal Fluid of the Male: And, in order to give a true Idea of this Mechanism, he says, that the Matrix conceives the Fœtus, as the Brain does Ideas. He undoubtedly wrote for those who already knew how Ideas are formed.

VERHEYEN followed the same Doctrine; with this Difference, however, that, for the Formation of the Fœtus, he established the Intromission of the Male Seed into the Fundus of the Matrix, without depending upon the Fermentation of HARVEY. This Contagion was really exposing the Modesty of Virgins to numberless Accidents.

WILLIAM LANGLEY was also an Oviparite. His Observations run in the same Strain with those of HARVEY.

JOSEPH DE AROMATARUS has first observed, that the Chicken is already formed, in the Egg, before Incubation.

MALPIGHI is also convinced of the same Opinion; and observes, that the white Apex, which, according to HARVEY, becomes the animated Point, is only a small Bubble, which contains the Embryo, the rough Cast of which increases in Proportion as it developes itself; whereas no such Thing is found in the Egg of a Hen never trod by the

the Cock. Whence it is very probable, that it was the Cock which introduced the Chicken into the Egg.

MALPIGHI, however, has not drawn this Conſequence from his Obſervations; for he thought that the Fœtus pre-exiſted in the Egg, and imagined to have ſeen it therein before the Coition of the Cock.

VALISNIERY has made new Diſcoveries, but has reaped no Advantage from them. By his Obſervations he proves, that the Teſticles in Females produce no Eggs, but that they are only Reſervoirs of the Lymph, or of the Fluid, which contributes to Generation; and yet concludes, that the Work of Generation is performed in the Teſticles of the Female, as well as in thoſe of the Male: And, with HARVEY, does not think that it is neceſſary the Male Seed ſhould enter into the Matrix to fecundate the Egg.

NUCK alledges Experiments in Favour of the Ovaria.

DU VERNEY was alſo an Oviparite; and his Opinion has been much in Vogue among Anatomiſts; but moſt ſtrongly oppoſed by MERY.

OF THE VERMICULISTS.

HARTSOEKER and LEWENHOECK were the firſt Authors of the Sect of Vermiculiſts, or thoſe who thought to have diſcerned, in the Male Semen, Animalculæ like Worms.

ANDRY, VALISNIERY, BOURGUET, and many other Authors, have thought the ſame.

DALEMPATIUS aſſerts, that he obſerved a Species of Bull-heads or Tadpoles therein, which developing themſelves, became diſtinct human Figures.

And

And the Vermiculites have ſuppoſed thoſe Animalculæ or Tadpoles to contain Fœtuſes in their primitive State.

Some of this Sect, not having intirely laid aſide the oviparous Syſtem, in order to reconcile both the Sects, pretend, that of a Million of Animalculæ, which float in the Semen, one or two only, and very ſeldom three, become perfect Fœtuſes; and that all others periſh, not being able to pierce that particular Part of the Pellicula through which they are to penetrate, and lodge in the Ovum, or Egg; this Aperture cloſing up, by a Valve, as ſoon as any have entered it.

Other Opinions more generally received.

The Author of the Venus Phyſica eſtabliſhes the uniting of the prolific Seed of both Sexes, and admits of what may be called the Redundancy of thoſe Fluids.

M. De Buffon was, in a great meaſure, inclined to the Syſtem of Hippocrates. He attributes to the Female, as well as to the Male, ſeminal Fluids, each of which contain organical Moleculæ, from the uniting of which a new Animal is formed.

Summary Reflections on the various Opinions of all the Authors before cited.

In the firſt Place, we ſhould aſk thoſe who divide Generation between the Male and the Female, Upon what Grounds they ſuppoſe the Male Seed, in order to Fecundation, to ſtand in Need of an extraneous Juice, or a cold Fluid, ſuch as that which the Female produces in Coition,

tion, whilſt it is, of itſelf, endowed with a Matter more warm and ſubtil?

In the next Place, if the Co-operation of the Female be neceſſary to the Formation of the Fœtus, we may aſk, How ſome Animals ingender without Females?

Are we then to admit of two Sorts of Generations? And why ſhould the Laws of Nature be multiplied, without any manner of Neceſſity, by ſuppoſing two of them; whereas one, only, is ſufficient, in all Caſes?

One Conſequence, in the Syſtem of Oviparists, I think it hard to admit of; which is, a Progreſſion decreaſing, ad infinitum, of Eggs contained one within the other.

Beſides, thoſe Eggs, being only a cold and lifeleſs Subſtance in oviparous Animals, and which never had any Exiſtence in the viviparous.

The Proof intended to be deduced from it, in Favour of the Exiſtence of Eggs in viviparous Animals, or of Fœtuſes found in the Abdomen, or Fallopian Tubes; admitting them as Facts, to me ſeems not concluſive; ſince it is very poſſible that the Seed of the Male might have introduced itſelf into thoſe Tubes, in Conſequence of their Dilatation; and that it either abides therein, or falls into the Abdomen, through the Morſus Diaboli, or the fringed Membrane.

Wherefore, in this Caſe, in lieu of the Fœtus falling down from the Ovarium, it is more probable, that it has reaſcended into the Tubes: For, otherwiſe, why ſhould no Fœtus ever have been found in the Ovarium?

A complete Confutation of the Syſtem of Oviparites, is to be found in the Works of M. De Buffon.

The Syſtem of Vermiculiſts ſeems to be no better grounded; ſince the Truth of thoſe Animalculæ,

culæ, floating in the Seed, appears to me but faintly eſtabliſhed. For who, among the vermiculite Phyſiologiſts, is able to aſſert, that thoſe Animalculæ exiſted in the Animal itſelf, before the Emiſſion of the Seed? Or diſprove that they were formed therein ſince the Fermentation or Corruption of the ſeminal Fluid, ſuch as are found in Vinegar, which did not previouſly exiſt in the Wine; or ſuch as are ſeen ſwimming in putrefied Water, which did not exiſt before Putrefaction?

To prove their Exiſtence, I could wiſh that thoſe Bodies were tranſparent; and that the Seed might be diſcernable in its very Receptacle: Till then, we have a Right to doubt, whether there be any Animalculæ in the Seed; or, at leaſt, whether thoſe Animalculæ are diminutive Men. For the Activity and Friſking which Vermiculites ſuppoſe in them, do not in the leaſt agree with the Sluggiſhneſs and Inactivity uſual in a Fœtus.

Hence it is not reaſonable to imagine that thoſe ſmall Embrios, in Proportion as they advance in their Conformation, by their complete Organization, ſhould loſe their Vigour and Agility.

Conjectures on the Formation of the Foetus. By Gautier. Inſerted in the Merc. Pariſ. 1750.

The probable Conjecture, as to the Formation of the Fœtus, is; that it is produced, under a fluid Form, in the ſeminal Veſicles of the Male, by the Concourſe of the Blood ſecreted by the Teſticles, and that of the animal Spirits, which, during the Act of Coition, ruſh into the ſaid Veſicles, by a Mechaniſm like that which has concurred to the Increaſe of the Parts of the ingendering Male; ſo as it is with thoſe Inſects which propagate without a Female, ſuch as Polypuſes, Vine-fretters,

fretters, &c. yet with this Difference, that, inſtead of the Young of Inſects, drawing their Nouriſhment and Growth from the Earth itſelf, or Plants, which ſerve them as a Placenta does the human Fœtus, as well as thoſe of other Animals, is formed in the Matrix of a Female, there to receive its Nouriſhment and Increaſe. In order to undergo this Tranſmutation, it comes forth extremely feeble, and even fluid, from the ſeminal Veſicles through the Verumontanum, and is ejected through the Urethra into the Matrix.

This, then, according to my Suppoſition, is a kind of Production from the Male, whence it has even received Nouriſhment, during ſome Moments, by means of the Fluid, which, proceeding from the Proſtatæ, alſo ſerves, at the Inſtant of the Emiſſion of the Fœtus, to preſerve it, in its ſoft and weakly State, intire, by the Invelopement it ſurrounds it with.

The Fœtus, being conveyed into the Matrix, is immediately nouriſhed there by the Semen of the Female, during the Time of its floating; and, when fixed, is, by the Anaſtomoſis of the ſanguineous Veſſels, conveyed through the Placenta, during its Stay in the Matrix.

This firſt Nutrition, which it receives from the Semen of the Mother, enables it to wait till it be ſupplied by the menſtrual Blood, tranſmitted by the umbilical Veſſels, which take Root in the Matrix. Conſequently it would be, in a Woman, a Defect capable of preventing Generation, if ſhe was not in a proper Condition to ſupply Nouriſhment to the Fœtus after ſhe has conceived.

To confirm my Conjecture, it is to be obſerved, that in all Male Animals are found two different Sorts of Semen; one clear and tranſparent, which probably is not the generative Fluid; the other more concocted and adheſive; wherein, by a proper

per Inſpection, the Fœtus is eaſily diſcerned. In one Ejaculation of the human Semen, generally one Fœtus only is to be diſcovered, though ſometimes two, or more, may be diſcernable; whereas in Quadrupeds, which are more fruitful, ſeveral may be ſeen floating in a clear and viſcid Fluid, produced by the Proſtatæ.

But if the Semen be interrupted, no Fœtus is to be found in it, at leaſt not intire, but only ſome imperfect Particles thereof.

The Oviparists, ſuch as are the Females of Birds, Serpents, &c. being unprovided with a Matrix to preſerve the Fœtus, have, inſtead thereof, Placentæ for its Nouriſhment. Theſe are the Placentæ which, in the Females of thoſe Animals, form what is called the Bunch of Grapes; and the ſame viſcid Matter which wraps up the Eggs, alſo invelopes the Fœtuſes faſtened thereto.

As to Fiſhes, the Male needs only caſt forth his Sperm at the ſame Inſtant when the Female ejects her Eggs; and conſidering the vaſt Quantity ſhe emits, ſome of them always meet with Sperm, and adhere thereto.

According to my Principles, I meet with no Difficulty to explain the Formation of Monſters, ariſing either from an Exceſs or a Deficiency of Semen; which is performed in the ſeminal Veſicles of the Male, either by the Concretion of two Fœtuſes confounded together, which very eaſily happens (the Subſtance of them being at that Time ſo ſoft and feeble), otherwiſe, by the Mutilation of the Fœtus at the ſame Time, which may as eaſily happen, for the ſame Reaſon.

Neither, in this State, is it in the Power of the Mother to prevent the Fœtus from receiving any external Impreſſion, Blemiſh, or Defect, whether proceeding from any Longing, Surprize, Paſſion,

or

or any Thing that cauſes any irregular Motion in the Animal Oeconomy.

The Reſemblance which is often obſerved between the Child and its Father or Mother, implies nothing contradictory to our Opinion; and is no more difficult to explain by our Principles, than any other Hypotheſis upon this Subject.

The Generation of Mules, itſelf, ſupports our Sentiment. Thoſe Animals produced by the Male Aſs, in Conjunction with a Mare, partake of the Nature of the Sire, whatever chiefly belongs to Conformation; ſuch as the Head, Ears, Rump, and Tail; and of the Mare, ſcarce any Thing elſe beſides the Bulk and Hair. So that they are, properly, large Aſſes covered with the Hair of Horſes; yet they have, under their Bellies, ſome long Hairs, from the Aſs.

If it be aſked, Why Mules do not propagate? The Anſwer is, 1. That this Queſtion is not particularly relative to our Syſtem. 2. That Inſtances might be cited of Mules which did ingender; and that there are daily ſeen Birds, of a mixed Species, which, nevertheleſs, do breed: And as much may be ſaid of Dogs. 3. That probably this Degeneration proceeds from the heterogeneous Nouriſhment which an Animal has received in the Matrix of the Female, which was originally deſtined for an Aſs. And ſince this Difference of Nouriſhment may be the Cauſe of the Deviation, as to Bulk and Hair; why may it not alſo alter the generative Faculty? Thus the Production of divers Species of Animals, and ſuch like Phænomena, are eaſily explained by the Syſtem we here propoſe; which, beſides, has this particular Advantage over all others; viz. that the Obſervations and Experiments made by all the Naturaliſts, who have adopted other Hypotheſes,

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ſo perfectly agree with ours, as though they had made them with a View of confirming the ſame.

Conformably to the Example of HARTSOEKER, who bethought himſelf (ſays the Author of the Venus Phyſica) to examine, with the Microſcope, that Fluid which commonly is not diſcernable with the naked, though perceptive Eye; I will relate here a moſt concluſive Obſervation, made in Support of my Syſtem, by a more modern Phyſiologiſt, on whoſe Exactneſs and Fidelity I can depend. Previous to this, I muſt aſk Pardon for it of my modeſt Readers, ſince it is impoſſible for me to ſuppreſs the moſt clear and deciſive Proof of this Argument, without regarding whether the Curioſity of a Phyſician be blameable, or not. Here follows the Fact.

He received human Semen in cold fair Water, at its immediate Exit from the Urethra, wherein he ſaw diſtinctly, even without the Aſſiſtance of Glaſſes, a white Fœtus, conſiſting of an opake and fluid Matter, the Head of which was larger than the reſt of the Body by one Third Part. At the Extremities of the Trunk hung four Filaments, which formed the Arms and Legs; the whole Difference between this ſmall Fœtus and an Embrio which has been lodged in the Matrix, is, that the Head was, at leaſt, one third Part larger than the Body; and it is without Doubt that this Diſproportion has prevented other Obſervers, who have made the ſame Experiment as my Phyſician, from making the ſame Diſcovery therein. They probably have taken the Head of the Fœtus for an Aggregate of Matter, more concocted, and thicker, than the reſt of the Semen; likewiſe the Arms, Legs, and Body, for Parts of the ſame Matter, ſhooting forth into Filaments, by reaſon of their Viſcidity. But the naked Eye ſuffices to convince

convince an attentive Obſerver, that thoſe viſcid and whitiſh Lumps are true Fœtuſes, the Parts of which being more diſtinctly perceived through Glaſſes, removes all manner of Doubt.

The ſame Phyſician has made the like Obſervation upon the Semen of Quadrupeds, and found, that none ſhewed more diſtinctly the Fœtus than that of an Aſs, which dropped into a Veſſel of Water.

He perceived therein a ſmall Aſs, formed of a yellowiſh, thick, and fluid Matter; and could eaſily diſcern a very large Head, Trunk, four Legs, and a Tail, floating in a diaphanous greeniſh Liquid.

He likewiſe made a third Experiment, which any Body may, if he pleaſes, repeat, after him. He opened a Hen, immediately after her having been trod by the Cock; wherein he diſcovered a Chicken already formed, of a white and fluid Matter, having a large Head, and the reſt of the Body very ſmall in Proportion; the Whole being faſtened to the Yolk of the Egg, and ſurrounded with a glutinous tranſparent Fluid.

If ſuch Facts, added to the Principles we have eſtabliſhed, though they do not inconteſtably convince us that the Male alone, in all Animals, produces the Fœtus ready formed; and that the Matrix of the Female ſerves only as a Receptacle wherein the Fœtus is depoſited, there to receive its Nouriſhment and Growth,

I confeſs, I have no ſtronger Arguments to offer, in Support of my Opinion; and I queſtion whether the Adverſaries to my Syſtem have any ſtronger to oppoſe.

In fine, this Syſtem, ſo far from containing any Thing either new, or repugnant to Reaſon, muſt be, on the contrary, univerſally received, as being

founded both on Reaſon, and demonſtrative Proofs deduced from Experiments.

The firſt Philoſophers before PLATO maintained, that the Semen of the Male, alone, contained all the Parts requiſite to form a Body; and conſidered the Fluid, wherewith the Matrix ſupplied the Fœtus, as they did the Moiſture which the Earth yields to the Nouriſhment and Growth of a Tree or Plant.

NON NOSTRUM INTER VOS TANTAS COMPONERE LITES.

REMARKS.

I muſt confeſs, that I have not yet met with any Syſtem of Generation that has given me the leaſt Satisfaction; but, on the contrary, all of them appear full of Abſurdities, and the Whole is ſo involved in Difficulties, that it is not an eaſy Taſk to explain it, notwithſtanding all the Pains which have been taken, by LEWENHOECK, to contrive Glaſſes to obſerve Animalculæ in the Male Semen. Whence he, and his Followers, deduced a new Syſtem, as it ſhould ſeem utterly romantic, and inconſiſtent with the Conduct of Nature obſervable in all her Productions. Thus, for Example, if 3000000000 Animalcules ſhould be included in a Quantity of Male Sperm ſufficient for the Production of a ſingle Animal, provided the Animal is produced by one of theſe Animalcules, all the reſt are ſuperfluous, and created for no End but to be immediately deſtroyed; we may then ſuppoſe that Providence aims very oddly, if obliged to load her Engine ſo enormouſly, in order to execute her Deſign. But in all other Inſtances we find, that the Author of Nature perpetually adapts much leſs compounded Means, in order to arrive at the deſigned Scope.

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We have therefore great Reason to believe, that the Generation of the Antients is not the only Thing neglected, and accomplished in a Manner extremely inartificial.

With respect to these Animalcules, I must observe, that they really exist, and are easily discernable by the Help of Glasses; but never, as far as I have been able to discover, whilst the Semen is fresh and uncorrupted. But the Semen of Animals corrupts in a very short Time, and then the Animalcules appear; and, perhaps, not before.

Something analogous to this happens to the Seed of Vegetables. Wheat, for Example, ground into Meal, whilst fresh, exhibits no Animalcules; but, when mixed with Water into Paste, and corrupted, great Numbers of Animalcules are discoverable in it, by the Help of Glasses. Now it seems to be equally probable, that the Animalcules, discernable in Wheat, the Seed of a Vegetable, should be Rudiments of the future Blade of Corn, as that Animalcules, in the corrupted Semen of an Animal, should be necessary to the Production of another similar to its Parent.

LECTURE XVII.

Of Conception.

THE two moſt commonly received Opinions of our Time, concerning Conception, are, that Men, as well as all other Animals, derive their Origin, in the ſame Manner as Hens and Birds, from an impregnated Egg, in which all the Parts of the Creature are contained, in Miniature, in the female Ovarium.

Thoſe of the viviparous Opinion ſay, that all the Parts, which are to compoſe the Fœtus, are in one of the Animalculæ of the male Semen.

What we are certain of is, that no Procreation can be performed without the Union of Male and Female*, for our own Species; and the male Semen ſhould enter the Fundus of the Uterus.

In ſome Fiſhes we obſerve no Copulation, but only a ſimple Friction of their generative Parts, for their Progenecy; but in our Species it is abſolutely neceſſary that the Semen Virile be conveyed into the Matrix; and cannot be admitted but only at the Time when the Female emits the Semen from her Teſtes, as the Antients called it; which is certainly true: For no Woman can con-

* Some Naturaliſts obſerve, that Snails, Earth Worms, &c. do not require Copulation; as theſe Animals, to all Appearance, are really Androgynes: Nevertheleſs, they copulate ſometimes with each other.

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ceive but at that Time; notwithſtanding what ſome Authors would make us believe.

MAURIEAU relates, that a young Lady declared to him, that her Huſband never introduced his Penis into her Vagina but only between the external Labia. But when a Woman is in a Love Paſſion, I think it is in her Power to be very ſenſible what ſhe does. Beſides, in that State the Orifice of the Womb deſcends into the Vagina, more or leſs: Nay, ſome Matrices are ſituated lower than others; and therefore may the more eaſily receive the Semen.

As to what HARVEY ſays concerning Mares, &c. viz. that they may conceive, very often, by only a ſimple Approach of the generative Parts of the Male to theirs; I think moſt Grooms will contradict this Notion. For they obſerve, when the Mare does not retain the Semen of the Horſe, ſhe is not impregnated, or covered, as it is termed.

Conception is the Formation of an Embryo in the Uterus, by a Woman, receiving the Embraces of a Man, and his Semen into her Matrix, which excites a convulſive Conſtriction and Attrition of the very ſenſible and tender Parts which lie within the Contiguity of the external Opening of the Vagina, after the ſame Manner as we obſerved in Man. By this means, the Return of the venal Blood being ſuppreſſed, the Clitoris grows turgid and erect, the Nymphæ ſwell on each Side, as well as the venal Plexus, which almoſt ſurrounds the whole Vagina, ſo as to raiſe the Pleaſure to the higheſt Degree: In Conſequence of which, there is expelled, by the muſcular Force of the Conſtrictor, but not always, a Quantity of lubricating mucous Liquor, of various Kinds; the principal Source of which is ſeated at the Beginning or firſt Opening of the Urethra, where there are large mucous Sinuſes, ſituated in the protuberant Mar-

gin of the urinary Duct. Beſides, there are two or three large Sinuſes, which open themſelves into the Cavity of the Vagina itſelf; and others on the Sides of the Urethra, at the Bottom of the Sinuſes, which are formed by the membranous Rugæ or Valves ſulcated ſuperiorly. Laſtly, On the Sides of the Vagina, between the Bottoms of the Nymphæ and Hymen, there is one Aperture, on each Side, from a very long Duct, which, deſcending towards the Anus, receives its Mucus from a Number of very ſmall Follicules.

But the ſame Action which, by increaſing the Pleaſure and Delight, cauſes a greater Conflux of Blood to the whole genital Syſtem of the Female, occaſions a much more important Alteration in the internal Parts: For the male Semen, penetrating the tender and ſenſible Cavity of the Uterus, which is itſelf now turgid with influent Blood, does there excite, at the ſame Time, a Turgeſcence and Diſtenſion of the lateral Tubes, which are very full of Veſſels, creeping between their two Tunics; and theſe Tubes, thus copiouſly filled with florid Blood, are ſuppoſed to become erect, and aſcend, ſo as to apply the rough or fringed Opening of the Tube to the Ovary, as is commonly believed.

The Semen depoſited in the Veſiculæ Seminales is in the Teſticles yellowiſh, thin, and aqueous; and it retains the ſame Nature in the Veſieles, only it becomes ſomewhat thicker, and higher coloured. It has a ſort of heavy or ſtrong Smell, of a peculiar kind, in each Claſs of Animals. Without the Conveyance of this Fluid into the Uterus, no Claſs of Animals, in each of which are two Sexes, can be fecundated ſo as to propagate its Species.

Since the Invention of the Microſcope, we have diſcovered in Man, as well as in all other male Animals, the ſeminal Liquor is full of living Animalculæ

malculæ reſembling Eels, only with larger Heads; and that theſe are always preſent in healthy Semen, from the Time, and in thoſe who are ſterile, from a Gonorrhæa, it is ſaid they are abſent. (That they are Animalculæ, appears evidently, from their various Motions, Reſtings, and Geſtures of Body; tho' with Age they are ſaid to dwindle, and loſe their Tails).

It has been much doubted what can be the Uſe of theſe Animalculæ, the like of which are not to be found in any other Liquors of our Bodies.

Some think, that they excite Irritations which incline to the venereal Appetite; and others have had various Thoughts: However, the moſt commonly received Opinion is, that a ſeminal Animalcula is the firſt Rudiment of our Species, almoſt in the ſame Manner as a Caterpillar or Grub is, which owes its Origin to a Fly.

This ſeems to be approved of, from the near Reſemblance of the Fœtus to its parent Stamen, from whence it was derived; which Stamen does not appear, unleſs the Female is fecundated by the Male. Moreover, this Opinion is confirmed; inaſmuch as Animals, generated from the two Sexes, generally have a greater Reſemblance to the Father than the Mother; inſomuch, that Diſeaſes and Defects of the Body and Mind run, for a long Time, through a Family, from the Grandfathers to the Children.

Add to this, that Inſects commonly undergo a Revolution of their Parts, ſomewhat like this of the Vermicles into a Fœtus. Theſe Vermicles are univerſally found in the Semen or Teſtes of Animals; and, conſequently, they ſeem to be of ſome very important Uſe.

Many Arguments have likewiſe been advanced in Oppoſition to this Hypotheſis, that the Gene-

ration of the Parts of the human Body is not made ſuddenly, or all together; but ſlowly, or by Appoſition: To which add, that Animals produced from a Mixture of different Kinds, as the Mule, &c. do not ſhew a perfect Delineation of the Male in ſeveral Parts of the Body; but are ſo far from ſeeming to proceed from one Parent only, that they evidently demonſtrate Marks of the Female as well as the Male; which would not be, if the Parts of the Body were firſt perfectly delineated in either Sex.

Another great Objection is, the great and uſeleſs Abundance of theſe Animalculæ, in which only one, among ſo many Thouſands, can come to Perfection. To which add, the Smalneſs of the Animalculæ, if compared to the Fœtus, and its Membranes, &c.

Every Thing being well conſidered, the Matter ſeems altogether obſcure; or rather more Truth appears in Favour of that Opinion which defends a ſucceſſive Formation of the Organs: A ſtrong Argument for which is, the organical Changes made in the Parts of the greateſt Conſequence, which are very differently diſpoſed in the incipient Fœtus, from what they are in one which is mature; more eſpecially in the Heart, which, out of a ſingle Canal, is apparently folded together into two Auricles, and two Ventricles; to which are afterwards added new Lungs, a new pulmonary Artery and Vein, with the firſt Rudiments of the Aorta and Vena Cava, laid ſo as to correſpond with one another.

But Experiments on the Polype which are found in freſh Waters, Crabs, Earth Worms, and the falling off of the Horns of Harts, again repairable; with Inſtances of maimed Parts reſtored, in other Animals; all theſe demonſtrate, that various animal

animal Organs, even thoſe ſufficiently complex, and of conſiderable Uſe, may be repaired, without the Aſſiſtance of any previous Rudiments, or directing Out-lines. In Conſequence of this weighty Argument is derived, from the organical Formation of Parts, out a mere Fluid, as we obſerved before, to be diſcernable in many Animals, where a gelatinous Humour is by Degrees hardened, or inſpiſſated into Bones, Muſcles, &c. We have ſomewhat analogous to this in Plants; in which the Wood, and all the Parts, are gradually formed, or built up, in an evident Manner, from a Fluid condenſed within a cellular Fabric; whilſt the ſame Power not only continues, but is likewiſe largely ſpread throughout every Branch of the whole Tree; inſomuch, that every Twig can produce a Root, Branch, Leaf, Flower, and Fruit.

But it may be aſked, Of what Uſe are the ſeminal Animalculæ? Whether they are the Rudiments of Fœtuſes undetermined, and requiring many Changes, by the Increaſe of ſome Parts, and Evolution or ſhrinking of others, to bring it, at length, to the human Shape, by a ſucceſſive Fabricature? Or whether there is any Truth at all in this Hypotheſis? Theſe Vermicles, which we ſee, being naturally bred in the Semen, as the like little Eel-like Animalculæ are bred in Vinegar, or other Infuſions of Herbs.

But it will be demanded, if it be ſo, Why the ſame Animalculæ are not to be found in other Fluids of the human Body?

The moſt antient Opinion of Generation (which ſtill prevails) is deſcribed in theſe Lines:

The Male's and Female's Seed agree to make
The tender Young; of both the Young partake:
But

But yet that Sex the Young resembles most,
That hath more powerful Seed, more vigorous Lust.
If Mother's, Her's; if Father's, then the Male's:

CREECH's LUCRETIUS, Book IV. ad Fin.

Add to this, that when the male Semen is injected into the Fundus of the Uterus, which cannot be admitted but at the Time when the Woman evacuates her Fluid, or Semen, as some will have it, without that critical Moment, no Conception can ensue.

The seminal Fluid is retained in the Vesicles as long as a Lad neither exercises Venery, nor sports in imaginary Dreams: But it is always a Stimulus to the animal Appetite of Venery, as long as it is there present in any Quantity, which becomes considerably strong, the volatile and odorous Particles of it absorbed in the Blood, where it produces wonderful Changes, as soon as it begins to be formed; such as the Protrusion of the Blood, the Covering of the Pubes, a Change of the Voice and Passions, Horn in Cattle, &c. for these Changes in the Animal are not only the Consequences of Age, but of the seminal Fluid, which we plainly see is different in Eunuchs, who are deprived of this Liquor; and likewise in female Animals, when their Testes are absent. The Growth and Strength of the castrated Animal are constantly diminished; and, in like manner, the Fierceness of their Tempers, and the strong Smell of their whole Bodies, are remarkably weakened.

In the female Testes, or Ovarium, of ripe Years, they are extremely turgid, with a lymphatic Fluid, which will harden like the White of an Egg, and with which little Bladders are dis-

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tended: Alſo, before Conception, there is generally formed, by Degrees, a kind of yellow Coagulum, within ſome Veſicle of the Ovary; which Subſtance increaſing very much, by Degrees, the Tunic of the Veſicle diſappears, and changes into a hemiſpherical yellow Subſtance (commonly called Corpus Luteum) ſomewhat like a Bunch of Currants; which Subſtance is internally concave, and includes in its Cavity, as far as we can perceive, the very minute concave Membranes, or Eggs, which are to be the Seats of future Fœtuſes *.

The Extremity of the Tube, therefore, ſurrounding and compreſſing the Ovarium in the fervent Congreſs, preſſes out and abſorbs a mature Ovum, from a Fiſſure in the external Membrane; whence it is continued down, by the periſtaltic Motion of the Tube, to the Uterus itſelf; which periſtaltic Motion begins from the Apex of Contact with the Ovum, and urges the ſame downwards ſucceſſively to the Aperture into the Fundus Uteri. This yellowiſh Subſtance is named Corpora Lutea, which is never abſent in prolific Females, but always forms a Protuberance; from the repeated and conſtant Obſervation of the Number of Scars or Fiſſures in the Ovarium being always conformable to the Number of Fœtuſes excluded by the Female †.

The Corpora Lutea, one would be apt to think, are the Females Semina: For how ridiculous is it to imagine that it is to coagulate the Orifice of

* This is the commonly received Opinion: But they appear to me to be Veſiculæ Seminales, the ſame as in Men, only not ſo large.

† It is amazing to me, that ſo many ingenious and learned Men will have it, that Women have Eggs, as Hens, Birds, Fiſhes, &c. to whom it is very neceſſary; as having no proper Matrices to nouriſh their Fœtuſes; and for the greater Fertility of their Species; as we ſee in Fiſhes, &c. who ſpawn the Multitude of Eggs they expel.

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the Uterus! Yet it never was obſerved, that the Ovum is included in the yellow Calix, in paſſing the Tube; nor how ſmall an Ovum is (as it is commonly called) in the Tube: For it is not ſmall enough to enter the Uterus, as this Paſſage is ſo narrow. And why may not the mucous Fluids coagulate the Semen Virile, and nouriſh it during the Embryo State?

It may be aſked, Whether the Seat of Conception be in ſome certain Part of the Uterus, to which Experiments ſhew that the male Semen is conveyed; or whether the Energy of the male Semen impregnates the Ovum, while it is yet lodged in the Ovary; as would ſeem to follow, from Examples of Fœtuſes found in and about the Ovarium, and in the Tube?

After Impregnation of the Uterus, its Cervix contracts; and for ſome Days after Conception has lain in the Matrix, the prolific Subſtance begins to ſend out, on all Sides, fleecy ſoft Branches from its including Membrane, which is, as yet, ſimple: Theſe Fleeces inoſculate and cohere with others of the ſame belonging to the floculent, exhaling, and abſorbing Veſſels of the Uterus internally; this Adheſion of the Placenta or prolific Matter, is made in all Parts of the Matrix, but more eſpecially in its thicker, which is the Fundus. By this Communication, a thin ſerous Humour paſſes from the villous Arteries of the Uterus, and abſorbs into the incloſed Membrane, which is thereby ſuſtained, together with the included Embryo; but before this Adheſion, it is either ſuſtained by the Matter it already contains, or elſe by ſuch Juices as it abſorbs from the ſurrounding Humours.

At this Time, in the Ovum, or Sacculus, there is a Quantity of a limpid aqueous Liquor, which, like the White of an Egg, hardens by the Heat of Fire,

Fire, or a Mixture with Alcohol; and now the inviſible Embryo firſt appears, with a very great Head, a ſmall ſlender Body, and, as yet, without Extremities, fixed by very broad flat Navel Veſſels to the obtuſe End of its included Membrane: From hence the Embryo continually increaſes, as well as its Appendages, but in a variable unequal Proportion: For while the arterial Serum is conveyed by more Paſſages open into the ſmaller Veſſels of the included Membrane, the Embryo itſelf grows the faſter; becauſe now the greater Part of what it ſuſtains ſeems to paſs through the ample and open umbilical Vein. At the ſame Time the Placenta grows alſo, but leſs in Proportion; and the aqueous Liquors, which it includes, gradually diminiſh from their firſt Proportion, in reſpect to the Bulk of the Fœtus. The fleecy Productions of the Veſſels from the included Membrane are gradually ſpread over with a continued Membrane, which makes the Chorion, between which and the Amnios they are intercepted: Of theſe, the greater Part diſappears below, or elſe terminates in the Chorion; and only thoſe which ſprout out from the obtuſe End of the Sacculus take Root, and increaſe ſo as to form a round Circumference named Placenta Uterina.

Such is the Appearance of the Riſe of Conception commonly in the ſecond Month; whence, afterwards, it changes only by increaſing in Bulk. That Part of the Sacculus next to the Fundus of the Matrix is commonly ſuperiorly, making about a third Part of its whole Surface, in Form of a flat round Diſh; ſucculent, and full of Protuberances, but throughout perfectly vaſcular, uniting, and interwoven with other Tubercles of the ſame kind, and with a thin cellular Fabric of the Uterus, accurately collects and connects the ſmall Veſſels of the Uterus, as exhaling Arteries, ſo as to

correſpond inſeparably with the inhaling or abſorbing Veins of the Placenta; and the wide-opening Veins of this laſt to the Veins of the Uterus. This Communication of the Veſſels appears evident from the Loſs of Blood which flows from the Separation of the Placenta in a Miſcarriage; and from the Blood of the Fœtus being exhauſted from an Hæmorrhage in the Mother; which enſue from the umbilical Veſſels, ſo as to kill the Mother when the Placenta has been left adhering to the Uterus; and, laſtly, by Injection of Quickſilver into the uterine Arteries which paſs into the Veſſels of the Placenta. Add to this, the Ceſſation of the Menſes, which Blood is abſorbed by the Fœtus.

The remaining unconnected Portion of the Sacculus Membrane, and likewiſe the Surface of the Placenta, are covered by an external villous and fleecy Membrane, full of Pores and capillary Veſſels of a reticular Texture, which eaſily lacerate, ſo as to reſemble a fine Placenta, and is named Chorion: But even this is, in ſome meaſure, connected to the Surface of the Uterus by very ſmall fleecy Veſſels, but leſs, and ſofter, than the Veſſels of the Placenta; but then theſe have internally a true ſolid Membrane ſpread under them as a Foundation, which may be either called the internal Lamella of the Chorion, or a ſecond diſtinct Membrane of the Fœtus.

False Conceptions and Moles.

Some of the Antients thought, that if the Parts of the Embryo and Secundines were not diſtinctly formed from the Mixture of the male and female Semen, they riſe to a Maſs, which, evacuated before the fourth Month, was named by them Falſe Conception; or if continued longer in the Ma-

trix, ſo as to increaſe, they termed it Mola; and others imagined that it was produced from the menſtrual Blood retained in the Uterus.

To illuſtrate this Opinion, they quoted Examples of virtuous Widows, who (they ſay) were delivered of Moles a long Time after the Death of their Huſbands.

But we are not ſo credulous now-a-days; therefore we affirm, that all Moles are real Conceptions, and cannot happen unleſs there has been ſome venereal Intercourſe between the two Sexes.

The Moderns have advanced two Hypotheſes to explain falſe Conceptions and Moles. The firſt is, that a Mole is a true Conception in its Origin, and has afterwards periſhed: Some, ſooner or later, that the including Membrane and Placenta were left adhering to the Uterus, as in the State of a Fœtus which receives its Nouriſhment when alive. Whence ſometimes it grows as large as a Fœtus, but in a deformed Maſs. The other is, that the Mole is a Veſicula, or Ovum, which was fecundated by a ſeminal Animalcula, but has adhered to the Uterus, and increaſed without an Embryo.

To corroborate this Opinion, they cite Examples of Moles wherein no Rudiments of Embryos could be diſcerned; whence they concluded, that an Animalcula had never entered it. But it is my humble Opinion, that if the Woman has never conceived, ſhe never had a Mole, as it is commonly termed.

As to thoſe Moles wherein no Veſtigia of an Embryo are not diſcernable; it is only owing to the early periſhing of the Embryo; otherwiſe it would appear viſible in Proportion to the Time it has lived in the Uterus.

To have an Idea of a decayed Embryo in a Mole, we may compare it to the withered Kernel of an Almond; in which the Shell is like the Mem-

Membrane and the Placenta which incloſes the Embryo or Fœtus.

The Cauſes of falſe Conceptions and Moles, or, more properly ſpeaking, Miſcarriage of Conception, are; 1. The Embryo or Fœtus may be deſtroyed by a Dropſy, Inflammation, &c. whence its Body becomes ſo dry and corrugated, that it will be almoſt imperceptible; eſpecially if that happens very early. Or the Embryo may die from a Miſconformation of the Organiſation of its Oeconomy or Appendages, or elſe want of receiving Nutrition, &c. In fine, a Defect in the Fœtus, or its annexed Parts, may cauſe the Deſtruction; which, as it happens ſooner or later, will make the Embryo or Fœtus more or leſs conſpicuous, ſo as ſometimes to diſtinguiſh what Sex it is; whilſt at other Times we cannot ſee even a Veſtigia.

As for the other Hypotheſis, that no ſeminal Animalcula has entered the Veſicula or Ovum, or becauſe they periſhed in the Uterus before the Ovum deſcends from the Ovarium, or be not dextrous enough to enter into the Ovum!

I, for my Part, think this Hypotheſis periſhes itſelf, as well as the Embryo, when Generation miſcarriages.

A Mole, or Miſconception, is of different Sizes and Subſtances, according to the Time it has remained in the Uterus. Some are pulpous, ſoft, and ſpongy; others membranous, &c. They have a Cavity, more or leſs large, in their Middle; this is ſometimes full of Seroſity, or Hydatides, as large as a Pigeon's Egg, &c.

It adheres to the Uterus like the Placenta, but has no Funis continued to it; its Formation is generally attended with the ſame Symptoms as a true Pregnancy, but the Continuance in the Matrix is very uncertain; for ſometimes it comes away like

Abortion,

Abortion, in about two, three, or four Months, with the ſame Evacuation of Blood, and commonly more violent; or it remains ſometimes for ſeveral Years, and becomes ſcirrhous, which communicates to the Uterus.

It is impoſſible to diſtinguiſh a falſe Conception from a true one for the firſt four or five Months: However, we may ſuſpect a Mole in the Uterus, when, upon any Motion, the Woman feels a Load or Weight like a Ball of Lead; when her Belly is round, and ſhe has not felt any Agitation in her Womb during the Time ſhe thought herſelf with Child.

Women are moſt ſubject to Moles when their Menſes begin to leave them, and ſometimes ſoon after they are married. Commonly this Miſconception comes away, before the End of nine Months, like an Abortion; ſometimes without Pains, but generally with a Flux of Blood.

The great Difficulty of Delivery is, when the Mole is very large, ſuch as ſome Authors have met with, as large as a full-grown Fœtus, nay bigger, as they relate; and there is no Motion or Contraction excited in the Uterus, as when there is a real Fœtus: For a Mole affords no Opportunity of being extracted. Whence ſeveral Women have died of it, when the Moles were large, and adhered cloſely to the internal Surface of the Uterus.

After the Excluſion of a Mole or Abortion, Examination ſhould be made to know whether it is a Mole, or Abortion. In the former, the Membranes are almoſt obliterated, and the Placenta makes more than one Half of the Volume; whilſt, in abortive Labours, it takes up no more than one Third of the Maſs. The Cavity in the Center is conſiderably diminiſhed, and much leſs in Proportion to the Size of the Placenta: Moreover,

when Abortions happen about the third or fourth Month, we always find the Embryo in a good State; but in the Case of a Mole, on the contrary, it is intirely corrugated.

In the Case of Abortion, the separating of the Placenta from the Uterus may be occasioned, 1. By the Extravasation of Blood, Milk, &c. between the Placenta and the Uterus. This intermediate Liquor will cause the Separation. 2. If the Placenta be contracted, and corrugated, it will separate from the Uterus. 3. The Placenta may be disengaged by violent Shocks, &c. The former are of the greatest Consequence.

They are deduced, 1. From the Virus of the Blood. 2. From the Embryo. 3. From the Uterus; or, 4. The Mother.

The Blood may cause Abortion by a too great or small Quantity; which two Causes are directly opposite to each other. Tho' the Fœtus requires a moderate Quantity of Blood, yet too much may create an inflammatory Infarction, or stop the Circulation, and so destroy the Fœtus; or the Plethora, which may lacerate the Vessels; violent Hæmorrhages, and an Inundation of the uterine Vessels; whereby the Placenta is separated; and, consequently, the Fœtus dies for Want of Nutrition. The longer it remains in the Uterus, the longer the Hæmorrhage continues; because the lacerated Vessels are kept dilated, which, in this Case, perform the Thing as a Ligature round the Arm in Venesection. Therefore the Fœtus should be extracted as soon as possible; otherwise the Mother and Child will perish.

2. An Abortion may happen from a Defect in the Fœtus, if the Circulation of the Blood be interrupted by any Obstacle, or if the Fœtus is too large and heavy, or dropsical; for the Weight and

Motion

Motion break the Adhesion of the Placenta from the Uterus.

3. The Uterus will give Room for Abortion, if it be too small, and cannot yield, or be sufficiently dilated by the increasing Fœtus and Placenta; or if it be not sufficiently pulpous, so as to receive the Placenta to adhere fixed, and not to yield to the least Effort of the great Quantity of Serum which bathes it. In the above Cases an Abortion is unavoidable.

4. By the Mother's Means; which may happen from violent Fevers, Vomitings, Tenesmus, Convulsions, &c. all which, by the Shocks they excite in the Body, frequently Cause an Abortion.

In regard to external Causes of Abortion, they are, strong Purgatives and Emmenagogues, which over-rarefy the Blood, and produce Hæmorrhages, sudden Passions, or Frights, Sorrow, &c. or violent Motions; as leaping, dancing, riding in jolting Carriages, raising too great Weights, Falls or Strokes on the Region of the Matrix, habitual Fluxes, immoderate Evacuations, &c. all these contribute to produce an Abortion in several Women; particularly, when the Union of the Placenta with the Uterus is not very firm.

We may observe, that there are several other Methods and Means of procuring Abortion. For how many abdominal Remedies do those miserable Women, who covet Abortion, make Use of, as Ministers to put their wicked Designs in Execution!

Though Miscarriages, in general, are dangerous; yet the Danger is not equally great in all its Cases: It varies, principally, according to the Time in which it happens; the Degree of the Symptoms, &c. for Abortion in the second or third Month, is less dangerous than when it happens in the fifth or sixth: Because, in the last

Caſe, the Fœtus is larger, and the Adheſion of the Placenta firmer; both which muſt be overcome before the Excluſion of the Fœtus: So that Abortion is reckoned more dangerous than a natural Birth; eſpecially when it is violent, or ſuddenly procured. For, in that Caſe, the Placenta is ſo diſtracted from the Uterus, that ſome of it frequently remains attached to that Organ; or, what is worſe, it brings along with it ſome of the very Subſtance of the Uterus, or burſts ſome of the collateral Veſſels; whence ariſe mortal Hæmorrhages, Ulcers, &c.

Several Inſtances of this Kind we read of in Authors of Veracity; and now and then they are met with in Practice.

The interior Membrane of the Fœtus, called Amnios, is of an aqueous pellucid Texture, very rarely ſpread with any conſpicuous Veſſels (which has not yet appeared very diſtinct in human Subjects), extremely ſmooth, in all Parts alike, and extended under the Placenta with the former, the Surface of which is every Way in Contact with the Waters with which the external Lamina of the Chorion and the cellular Subſtance is connected.

The Urachus, it is ſaid, has been found in ſome human Fœtuſes perforated*.

Monro (in the Medical Eſſays, Vol. II.) thought he ſaw the Allantoïs Membrane in our Species; but I think it is nothing but the cellulous Membrane between the Chorion and Amnios which connects them.

There is a Membrane placed between the Chorion and Amnios which covers the ſmooth Surface

* Vid. Memoires de la Royal Acad. des Sciences 1701.

Littre has given us Inſtances of this in two Children. He alſo ſays, that he found the Allantoïd or urinary Membrane in the ſame Subjects, which made him ſuſpect that this Membrane is likewiſe in our Species, as well as in Quadrupedes. He gives us alſo Obſervations of two Men whoſe Cervices of their Bladders, being obſtructed, diſcharged the Urine by the Navel.

of

of the Placenta, and furniſhes Vaginæ to the umbilical Veſſels*.

Observations.

Littre has preſented to the Academy of Sciences † a fecundated Egg (as he called it), which was incloſed in the Ovary. It was obſervable, that the ſmall Embryo was a Line and a Half thick, and about three Lines long, and floated in a clear mucilaginous Liquor.

He ſays, that he has obſerved, without a Microſcope, the umbilical Veſſels which incloſe the Embryo.

Several Authors relate Hiſtories of Fœtuſes falling into the Abdomen, without any Laceration of the Uterus, or the Tubes.

Courtial ſays‡, that he ſaw a Fœtus, in the Abdomen, with its umbilical Veſſels round the Neck; and whoſe Placenta, which was ſituated under the Stomach, communicated with the Gaſtro-epiploic Veſſels.

Littre ſays‖, that he found a Fœtus in the Fallopian Tubes.

Dionis mentions two Inſtances of this Sort: The firſt of a Woman of Tholouſe, in whoſe Abdomen was found a Fœtus included in a ſhapeleſs Maſs, in which it was thought to have been twenty-five Years. This Fœtus weighed eight Pounds.

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* See Rohault's Memoirs of the Royal Academy of Sciences 1714, 1716, 1718. Alſo Hobokenus De Anat. Secund. Human. Diemerbroeck's Anat. Lib. 1. and Needham. Obſervat. Anat.

† Vid. Memoires de la Royal Acad. des Sciences 1701:

‡ See his Obſerv. Anat. Alſo Tho. Bartholin. Hiſt. Anatom. Cent. VI. Miſcel. Medico-Phyſic. Obſerv. CX.

‖ Vid. Memoires de l'Acad. Royal des Sciences 1702. alſo Riolan. Anthropograph. Lib. II. and Act. Erud. Leipſ. 1701.

The other, which he was an Eye-witneſs of, was a Fœtus about five or ſix Months old, found in the Abdomen; and had, during that Time, remained in a Bag, which was connected to the Uterus, and appeared to be a Portion of; having a particular Tube, Ovary, Ligamentum Latum, and Rotundum; but, being carefully examined, it was found that its Cavity had no Communication with the Uterus, but was only united to it by ſome Veſſels covered with Membranes. This Bag burſting, left the Fœtus to drop down into the Abdomen, and the Woman died. See DIONIS's Anatomy.

We meet with another Caſe of a Woman about thirty Years of Age, who evacuated by Stool ſeveral Bones of a Fœtus about ſix Years old.

LITTRE, who had the Care of the Patient, finding that the Uterus was in its natural State, and being informed that nothing was brought from it during Geſtation; thruſt his Finger into the Rectum, the Side of which he found perforated about an Inch and a Half in Extent, and through which he felt the Bones of the Head of the Fœtus, which he laid hold of with his cutting Forceps: By this means he extracted them, and the Woman was perfectly recovered.

He well obſerves, that the Fœtus had been included in a Bag about three Lines thick, from the Fragments which came away with the Bones *.

All theſe Obſervations are not weighty enough to prove that our Species ariſe from an Ovum. As to thoſe Fœtuſes found in the Fallopian Tubes, they are nothing elſe but thro' a Dilatation of the Uterus after Conception, as other Parts of the Vif-

* Vid. Memoires de l'Acad. des Sciences 1702. Somewhat like it is alſo to be met with in AMIAND's Obſervations on Deliveries. See likewiſe BARTHOLIN. De inſolitis Partus Humani.

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cera do in ſome Diſeaſes: So that if the Placenta does not adhere to ſome Part of the Matrix, then the Circulation ceaſes, and the Fœtus immediately dies. Or if the Uterus happens to dilate, and afterwards lacerates where its Sinuſes communicate with the Veſſels of the Placenta, the Mother dies immediately.

Some Authors relate, that they have found Fœtuſes which have burſt the Matrices by their violent Geſtation.

Thoſe who are deſirous of having more Caſes concerning Fœtuſes found in the Fallopian Tubes, and Cavity of the Abdomen, may peruſe the following Authors; viz. MAGNET. Theatr. Anat. Tom. II. & Bibl. Chirurg. Tom. II. ANELLUS's Diſſertation ſur la Generation de l'Homme. VIEUSSENS Diſſert. de Struct. & Uſu Uteri. STRAUSSIUS Hiſtor. Fœtus. BAYLE Hiſt. Anatom. Gravid. ELHOLTZIUS de Conceptu Tubario. BUSSIERE. Philoſophical Tranſactions for the Year 1694. DU VERNEY Epiſt. de Fœtu. CYPRIANUS Obſervat. Anatom. BIANCHUS Theatr. Anatom. and an extraordinary Caſe in SANTORINI Diſc. de la Generat.

VALLISNERI has wrote very ingeniouſly on Generation in Italian.

LECTURE XVIII.

Of the Foetus in Utero, its Accretion, Nutrition, &c.

AFTER Conception, the Embryo increaſes gradually. The Encephalon, or Head, and its Appendages, are firſt formed, and completed; then the Viſcera of the Thorax, and afterwards thoſe of the Abdomen, with its Contents; and, laſtly, its Extremities ſprout out of its Trunk like Tubercles: Thus the wonderful Anthropogeneſis of the Mechaniſm of the human Fabricature are formed.

Perhaps it may be aſked, By what Cauſe the Parts of our Species are thus ſucceſſively conſtructed? Whether this be the Employment of the Anima, or Mind? We anſwer, That this does not ſeem an adequate Cauſe; ſhe being both ignorant of herſelf, and incapable to judge of Nature's Ends or Purpoſes, for which the ſeveral Organs, and their Actions, are to be employed, by a juſt Mechaniſm of the ſeveral Members in the Fœtus.

Or it will be queſtioned, Whether the firſt Rudiments, or Filaments, being contained either in the Ovum, or in the male Semen, are only afterwards diſplayed, and fitted out, by more plentiful flowing Juices? For this, we have neither any

any Delineation demonſtrable in the Ovum, as it is called, nor in the male Semen? Or whether, in Conſequence of the Power of Attraction, by which Nature performs all her other Operations, the viſcid Liquor of the Female altered, or that of the male Semen, does not firſt run together into a Filament, which, under unknown Circumſtances, increaſes to a Web of Fibres, thoſe into Membranes, Membranes into Veſſels, and theſe again into Muſcles; which, at length, condenſe into Bones, and all the Parts of the Body? We muſt give it as our Opinion, that this ſeems to be the moſt probable.

But we ſhall alſo demand, What can be the Intent of the wiſe Director of ſuch a conſtant, curious, and ſo exact an Edifice, in ſo great a Variety of Parts, and to ſuch a Number of particular Uſes?

We anſwer, That it is, doubtleſs, the ſame ever-acting and permanent Laws of the wiſe Creator, by whom freezing Spicula, Cryſtal of Salts, the Particles of mineral Ores, the terreſtrial Globules of Stones, and the ſandy Glebes of Gems or Cryſtals, are ſo elegantly or geometrically conſtructed; by which the fine Duſt of Moſſes, and Filaments of Flax or Cotton, or the Jelly of fungous Tribes, with the different Juices of Plants and their Appendages, are ſo variouſly modulated. The ſame Power, under various Circumſtances, certainly ordains the unorganiſed Parts of ſuitable Matter into the tubular Webs and Fibres of Vegetables, the Glue of the more ſimple Inſect and Shell Animals, the terreſtrial Stamina of the Blood and finer Juices of the more perfect Animals, into ſuch various Filaments, cellular Webs, and vaſcular Membranes, &c. as can be only the Effect of definite Laws, operating on the ſame kind of ſuitable Matter,

and

and under a Variety of Circumſtances or Conditions perfectly ſimilar.

Need we go farther for a Proof of this, than the ſucceſſive Germination of the Viſcera and Extremities in a Fœtus; in which, as in the Polype, we ſee ſuperior and inferior Extremities riſe inſenſibly, not as Filaments, but equally, from Tubercles, which (like Trees) grow, in Length, in Proportion as they increaſe in Thickneſs, and are unequally dilated?

Conſider, if the ſucceſſive Formation of the Heart, out of a ſingle Tube, in a Fœtus or Chick, afterwards curiouſly complicated, and then, by Degrees, ſhielded within a Craticle of the Ribs, &c. Will not this be enough to turn the Balance of our preſent Inquiry? eſpecially if we conſider well the Series of Growth in Plants, Polypes, Inſects, Chickens, the feathered Tribe, and in Fœtuſes of our own Species, leiſurely compoſed together?

From the Conception of the Embryo till the State of the Fœtus, it is probable, that it receives Nutrition from a kind of oozing Liquor, in which it ſwims, through the Pores of its Subſtance. For we are to conſider Conception thus: Firſt, The Membranes in which the prolific Matter is contained, and which is preſerved in Form of a Veſicle; it is very probable, alſo, that the Placenta is at firſt only formed of the ſmall Veſſels which fixed the conceptive Matter in the Uterus, where the Fœtus is formed, and nouriſhed by the umbilical Veſſels. Laſtly, By the Mouth alſo, as ſome Authors will have it; when the Mouth, Oeſophagus, Stomach, &c. are formed with the Liquor in which it ſwims.

The uterine Veſſels depoſit the nutritive Juices through the umbilical Vein, which ariſe from the Roots of the exhaling uterine Veſſels, which have a ma-

a manifeſt Communication with ſome Roots of the umbilical Artery, from whence it partly riſes; and, uniting in a larger Trunk, it is twiſted, in a circular Manner, through a Number of Circumvolutions, to a ſufficient Length, that may allow of a free Motion; and in its Courſe it is ſurrounded with a cellular Subſtance full of Mucus, diſtinguiſhed by three Partitions, and the Membrane, which is continued both to the Amnios and Peritonæum of the Fœtus; and, after forming ſome Protuberances, it enters through the Navel in an Arch made by a parting of the Skin and abdominal Muſcles, and goes on through the proper Sinus of the Liver, into which the ſmaller Portion of the Blood that it conveys is poured through the ſlender Ductus Venoſus into the Vena Cava, ſituated in the poſterior hypatic Foſſa; but the greater Portion of the Blood goes through the large hepatic Branches, which conſtantly riſe from its Sulcus, and remains even in Adults; but from thence it goes to the Heart by the continuous Branches of the Vena Cava.

It may be aſked, Whether the Circulation be reverſed in the Liver of the Fœtus? Whether the Sinus or left Branch of the Vena Portarum be not a Part of the umbilical Vein itſelf, ſo as to convey the Blood, by its Branches, from the Cava, whilſt only the right Branch conveys the Blood of the Meſentery and Spleen through the Liver? and Whether this Motion is allowable from the different and almoſt contrary Direction of the Blood from the umbilical Vein, and that brought from the Meſentery; ſince there is no Septum to diſtinguiſh between the umbilical Vein?

The Blood of the Vena Cava paſſes to the Auricle of the Heart through the Foramen Ovale: The Blood which has entered the right Ventricle, being forced out of it by its Contraction, paſſes through

through the pulmonary Artery which corresponds to that Ventricle, and there the Blood is divided, that is, one Portion of it passes into the Aorta Inferior, by means of the arterial Canal, whilst the other Portion, which is less considerable, goes to the Lungs.

The Portion of Blood which we observe passes into the left Auricle by means of the Foramen Ovale, mixes in that Auricle with the Portion of Blood which returns from the Lungs, the pulmonary Vein, and these Portions of Blood afterwards pass into the left Ventricle, which, by its Contraction, forces them to enter into the Aorta, and to flow through its different Ramifications. According to this Description, the Valve of the Foramen Ovale hinders the Blood from passing the left into the right Auricle.

Mery * maintains the contrary to what we advance here. He thinks, that the Blood passes in as great a Quantity to the Lungs, as if the Fœtus respired. He founds this Opinion on the considerable Diameter of the pulmonary Artery of the Fœtus, and thinks, that the Blood which returns into the left Auricle, enters partly into the Ventricle on the same Side, whilst the other Portion passes through the Foramen Ovale to discharge itself into the right Auricle.

Winslow considers the two Auricles of the Fœtus's Heart as only forming one with respect to the Foramen Ovale, and the two Ventricles as one with regard to the arterial Canal; and, lastly, the Lungs of the Fœtus with respect to the Circulation of the Blood, as another Organ whose Use is unknown. This being granted, it appears reasonable to him, to think that the Blood, which re-

* Memoires de l'Acad. Royal des Sciences 1699 & 1701.

turns

turns by the Vena Cava into the right Auricle, without any Impetuosity, meets with that which returns from the Lungs in the left Auricle; that they mix in the Diastole of the Auricles, and by that means they become an uniform Fluid, and equally impregnated with that from the Placenta, so to be propelled through the two Ventricles as through one, and to be equally distributed through the pulmonary Artery, the arterial Canal, and the Aorta, as through one single arterial Trunk, to all the Parts in general.

He ascribes no other Use to the Valve of the Foramen Ovale, than to form an intire Partition, after Birth, between the two Auricles which close up the Passage of the one to the other.

At the Beginning of the Vena Cava Inferior, we find a Valve, called, from its Discoverer, Eustachin. It is commonly membranous, and sometimes of a reticular Texture: Its Figure is nearly that of a Crescent; the convex Margin is turned inferiorly, and adheres internally to the anterior Sides of the Vena Cava Inferior; and of the two Horns of the Crescent, one terminates anteriorly in the Margin of the Foramen Ovale next to the Parts of the Auricle; and the other adheres to the posterior Margin of the same Foramen, and also to that Part next to the Auricle; so that, being arched or separated from the Sides of the Vena Cava, it is applied over the Partition of the Auricle near the Basis of the Heart. As this Valve is generally more extended in Proportion in a Fœtus, than in Adults; WINSLOW * thinks, that it prevents the Blood of the Auricles from regurgitating into the Vena Cava Inferior; whence it

* Vid. Memoires de l'Acad. des Sciences, 1717, & 1725. Ibid. 1708. See TAUVRY's Treatise on the Fœtus.

might

might alſo regurgitate into the umbilical Vein, if it would not hinder Reſpiration in the Fœtus. Whilſt included in its Membranes in the Uterus, it was neceſſary that it ſhould receive a nutritious Fluid and Blood which have been impregnated with Air.

It is evident, that this Quantity of Fluid, continually furniſhed by the umbilical Vein, would unavoidably overload the Fœtus, if the ſuperfluous was not returned into the placentine Arteries.

The Placenta was called by the Antients, from the Likeneſs it bears to the Liver, Hepar Uterinum.

The Number of Placentæ in human Subjects anſwers to that of the Fœtuſes: As theſe are uſually ſingle, the Placenta is likewiſe ſo: When there are two or more Fœtuſes, there are always as many Placentæ; but, in this Caſe, they often cohere one to another, ſo as to ſeem but one Subſtance: But, even in this Caſe, their Veſſels do not communicate with each other.

In Quadrupeds, particularly Cows, there are often a great Number of Placentæ, ſometimes not leſs than a Hundred, to one Fœtus. In this Caſe, they are called Cotylidones. The Figure of the Placenta is ſomewhat orbicular; its Diameter is eight or nine Inches, and its Thickneſs about an Inch. Its convex and ſpongy Surface is connected to the Uterus by means of a very thin Membrane, which is reticular, villous, and continuous with the Chorion; its concave Surface is turned towards the Fœtus, connected to the Funiculus, and ſurrounded with a ſmooth Membrane from the Chorion and Amnios. It has no fixed or certain Part in the Uterus to adhere to; but is uſually fixed to the Fundus.

The greateſt Part of the Blood is returned from the Fœtus to the Placenta by two large Arteries,

which generally riſe from the Iliac on each Side, ſometimes from the inferior Portion of the Aorta, which are continued on in the Direction of the Aorta; and, after giving ſome ſlender Ramifications to the Femorals, with ſtill ſmaller Arteries into the Pelvis, they aſcend reflected back with the Bladder on each Side of it, ſurrounded with the cellular Lamina of the Peritonæum, with ſome Fibres ſpreading to them from the Bladder and Ureter; in which paſſing alternately, in a ſtreight and contorted Courſe, they form various Twiſtings or Windings, ſomewhat ſharper than thoſe of the Vein which they accompany; in which Manner they at laſt arrive at the Placenta, whoſe Subſtance is formed of their Branches, in Conjunction with thoſe of their correſponding Vein. By theſe Branches, the Blood ſeems to paſs out through minute Arteries of the Placenta, into the bibulous Veins of the maternal Uterus, that, after undergoing the Action of the Lungs by the Mother's Reſpiration, it may return again, in an improved State, to the Fœtus: For what other Reaſon can be aſſigned for ſuch large Arteries, which carry off above a third Part of the Blood in the Fœtus to the Placenta and Matrix?

Moſt Anatomiſts will have the Placenta of a glandulous Subſtance. They affirm, that it is compoſed of a Multitude of minute Glands; but have not been able to demonſtrate them.

We may be convinced that the Placenta is nothing elſe but a Congeries of Veſſels, by macerating with proper Care. I have prepared ſome, which I keep by me, wherein the minute Extremities of the Arteries and Veins are diſtorted and injected.

There are two Opinions concerning the Ramification of the umbilical Arteries: Some think, that theſe Veſſels form Anaſtomoſes with the Ramification

mification of the umbilical Vein; others pretend, that they do not terminate in the Placenta; but, having paſſed through it, loſe themſelves in the ſpongeous Subſtance of the Uterus, there diſcharging the Blood which they bring to the Fœtus; which being reſorbed by the uterine Veins, by which means they, endeavouring to eſtabliſh a Circulation between the Child and Mother, as the umbilical Vein with that of the Mother.

The other Opinion, which is inconſiſtent with Experiments, is, that the Mother furniſhes no Blood to the Fœtus, but only a lacteal Juice; which, according to them, is ſecreted by the uterine Glands, which, they alſo ſay, are to be found on the internal Surface of the Uterus, and which is reſorbed by the Ramifications of the umbilical Vein.

They affirm, that there is a Communication between the Fœtus and the Mother, which they are ſuppoſed to have proved.

As for the Glands of the Uterus, MERY, and ſeveral other Anatomiſts, deny their Exiſtence; and, to prove that the Mother really furniſhes Blood to the Fœtus, and not ſimply a lacteal Juice, they ſay, that, after Expulſion of the Fœtus, if we cut the Funis Umbilicalis without a Ligature, and the Placenta adhering to the Uterus, the Blood of the Mother flows from the umbilical Vein.

Does not this ſeem an inconteſtable Proof that the Blood of the Mother paſſes to the Fœtus thro' the umbilical Vein? For it cannot be ſuppoſed that the umbilical Arteries can convey the Blood of the Fœtus to the Placenta when the umbilical Veſſels are cut off; nor can it reaſonably be ſuppoſed, that the Placenta furniſhes all the Blood diſcharged from thoſe Women in whom no Ligature has been made on the Portion of the umbilical

Veſſels

Veſſels adhering to the Placenta, ſince we can hardly have a Porringer full of Blood from it, when ſeparated from the Matrix.

We are to obſerve, with reſpect to this ſecond Opinion, concerning the reciprocal Circulation between the Mother and the Fœtus, that the Arteries of the Mother communicate with the umbilical Vein, and the umbilical Arteries of the Fœtus with the Veins of the Mother. We are not to imagine that theſe Communications are immediate, that is, theſe Veſſels are united to each other, but only that the Arteries of the Mother open into Cellules or Pores of the Placenta, in which the Orifices of the umbilical Veſſels abſorb the Blood, afterwards to tranſmit it to the Trunk of that Vein, and the umbilical Arteries open into the Pores of the Uterus, where the Orifices of the Ramifications of the uterine Veins receive that which theſe Arteries carry thither, to exonerate it afterwards to the Trunk of the Hypogaſtrics.

Wherefore we ought not to be ſurpriſed, if, during Geſtation, the Placenta is ſeparated, either in whole, or in part; and ſhould happen Hæmorrhages, and ſubſiſt till the Woman is delivered of the Fœtus and Placenta, which permits the Uterus to contract its Orifices which correſpond to thoſe of the Placenta.

In this Caſe, we ought to uſe all Means to deliver the Woman, in whatever Period of Pregnancy ſhe happens to be.

The Adheſion of the Placenta to the Matrix is not fixed by the immediate Union of the uterine Veſſels with thoſe of the Fœtus; for it only ſeems to depend chiefly on the Inequalities of the Surface of the Uterus, and thoſe of the Placenta, received reciprocally into the ſmall Cavities found

between theſe Eminencies, from which they are obliged to depart when the Uterus contracts.

It is commonly thought, that the Fœtus is nouriſhed only by the lacteal Fluid of the Matrix, which the placentine Veins receive and convey from the umbilical Veſſel to the Fœtus. Till the Organs of Digeſtion are ſufficiently ſtrong for their Functions, it alſo receives Nutrition by the Mouth. It remains a Queſtion, Whether it does not ſwallow up the lymphatic Liquor contained in the Cavity of the Amnios, in which it ſeems to ſwim, and which is of a coagulable Nature, like the nutritious Serum? According to this Opinion, there ſeems to be ſome Analogy between it and the White of an Egg, in which Chickens are nouriſhed whilſt in the Shell; which is certainly ſo, as they have no umbilical Veſſels. But how the Circulation is performed in them, has not yet been well explained, I think.

For ſhould Fœtuſes open their Mouths, they would certainly be in Danger of being ſuffocated by the Loquor Amnii.

We find, alſo, in the Uterus of the Fœtus, a Mucus, ſomewhat like that in the Stomach, &c. Shall we ſay that this Mucus ariſes from the Amnios Fluid?

But I think we may ſafely conclude, with De la Courvec, De Nutritione Foetus in Utero Paradoxa.

Petit endeavours to prove, that the Fœtus can ſuck and ſwallow the Liquor, without the Aſſiſtance of Reſpiration. He has read a Memoir to the Royal Academy of Sciences at Paris; wherein he compares the Mouth of a Fœtus to a Pump, and the Tongue to its Sucker.

Heister has made Experiments on the Fœtus taken from a Cow involved in its Membranes, with the

the Liquor called Amnia, which was frozen about it: The ſame was found alſo in the Mouth, Oeſophagus, and Stomach, of a Calf. Whence he concluded, that the human Fœtus receives Nutriment by the Mouth alſo.

This Experiment of HEISTER to me appears nothing at all probable. The Cow was dead before the Fœtus was taken out of her Belly; and probably, in dying, the Fœtus opened its Mouth, and ſwallowed that Liquor found in it.

I am of Opinion, that the Fœtuſes do not open their Mouths, or Eyes, whilſt in the Uterus; but that they are in a contracted State: Beſides, we have Examples of human Fœtuſes found born with their Mouths and Noſes unperforated; alſo of Puppies juſt littered, which have been ſhewn to the Royal Academy of Sciences at Paris, with their Mouths ſo: Therefore they could not have received Nouriſhment by them.

Perhaps I ſhall be aſked, What is that Mucus commonly found in the Oeſophagus, Stomach, &c. of Fœtuſes?

I anſwer, Nothing elſe but a Secretion from the glandulous Membranes of thoſe Parts; which thus ſecreted, in Proceſs of Time the thickeſt Portion forms what is called the Meconium, which is conſtantly found in the Inteſtines.

As to what FRED. HOFFMAN relates*, of a Child, born at its full Time, whoſe Funiculus Umbilicalis was entirely corrupted, and the Child perfectly well; he and PETIT account for it from the twiſting of the umbilical Veſſels, which theſe Authors ſuppoſe the Child to have remained ſome Time ſo in the Matrix.

* Vid. Act. Nat. Curioſ. Dec. 2. Ann. 7. Obſerv. CCIX. STEP. VANDER WIEL. Obſerv. Cent. II. Journal des Sçavans, Ann. 1687, &c.

I do not ſuſpect the Relations of theſe Authors: But the State of the Fœtus in Utero, with reſpect to the Circulation of the Blood between it and the Placenta, if not the Matrix alſo; appears, to me, entirely inconſiſtent with the known Laws of the Animal Oeconomy.

It is proper I ſhould obſerve here, that the Liquor we find the Fœtus contained in, when young, and that which is evacuated at the Time of Delivery, is very different; for the latter is aqueous, and not ſerous, as at the Beginning of the Formation of the Fœtus.

In this Obſervation I am inclined to think, that Authors have not conſidered the Difference: For this aqueous Liquor may ariſe from the placentine exhaling Veſſels, perhaps the Fœtus itſelf, and not be of the ſame Nature; which we find in Abortion.

The ingenious HALLER *, after others, obſerves, that all the excremental Fæces, which are collected in the Inteſtines of the Fœtus, which is a dark greeniſh Pulp, may, poſſibly, be the Remains of the Bile, and other exhaling Juices.

And the ſame Author alſo queſtions whether the Fœtus has not an Allantoïd; ſince it is certain, that there paſſes out from the Top of its Bladder a Duct, which is at firſt broad, covered by the longitudinal Fibres of the Bladder, as with a Capſule; and afterwards, when thoſe Fibres have departed from each other, they are continued thin, but concave, for a conſiderable Way over the umbilical Veſſels, whence they have been traced by SWAMMERDAM †, Dr. HALE, and other eminent Anatomiſts, to the Expanſion of the Placenta, under this Denomination! Whether this, although it be not yet evident in the human Fœtuſes, is not

* Vid. Phyſiolog.

† See Philoſophical Tranſactions, N° 271.

con-

confirmed by the Analogy of Brutes, which have both an Urachus, and an Allantois!

But as for any proper Receptacle, continuous with the concave Urachus, it either has not yet been obſerved with ſufficient Certainty, or elſe the Experiment has not been often enough repeated to become general in the human Species: For we know, that, in the human Fœtus, the Urine is ſeparated but in a very ſmall Quantity. But it may perhaps be no improbable Conjecture, that ſome Portion of it is conveyed, by a certain latent Manner, into the Funiculus Umbilicalis, and there transfuſed into the ſpongy cellular Texture which ſurrounds the umbilical Veſſels*.

The Circulation of the Blood is peculiar in the Fœtus: For in Adults, the Blood, on the contrary, flows from the left Sinus to that of the right Auricle of the Heart. This is evident, from all manner of Experiments and Obſervations. For, 1. The Column of Blood in the right Sinus, is, of all others, the largeſt: and as it is the returning one from the whole Body, it cannot be exceeded by any other: But the left Auricle has ſo much leſs Blood, in Proportion, than that of the right, inaſmuch as Part of it flows through the

* SCHENKIUS ſays, that a Man, who had his Navel cut off by Accident, from that Time evacuated his Urine through that Place, in lieu of the Urethra. He alſo has obſerved in another Man, who by ſome Diſorder was diſabled from emptying his Bladder, that he had a Tumor formed round the Navel; which breaking, he ever afterwards evacuated it through the Urachus.

THOMAS BARTHOLINE ſays, in his Anatomy, Lib. VII. Cap. XXXVII. that in Miſcarriages, or new-born Infants, the Membrane of the Urachus is very obvious; but I muſt own, that I never could perceive it.

I am of Opinion, that the Urine muſt be evacuated from the Bladder's Attraction; as it is granted that the Fœtus does reſpire. Therefore the Diaphragm is inactive, and alſo the abdominal Muſcles; which, with the ſaline Particles of the Urine in Adults, and the Contraction of the Bladder, are the Means by which we make Water, which are entirely abſent in the Fœtus.

Duct or Canalis Arteriosus into the Aorta, whence its Contents will be much less than that of the right Auricle: Besides, the Valve of the Foramen Ovale, in a mature Fœtus, is so large, and placed so much to the left of the muscular Isthmus or Arch, that, when it is impelled by the Blood from the left Side, the Valve, like a Shutter, closes up the Foramen; but, being impelled from the right Side, it readily gives way, so as easily to transmit it either into the Blood or Flatus.

There is but a small Portion of the same Blood which first entered the right Auricle and Ventricle of the Heart, that takes its Course through the Lungs: For the pulmonary Artery, being (in the Fœtus) much larger than the Aorta, is directly continued to the latter by an Aperture named the Ductus Arteriosus, which is larger than the Diameter of both the pulmonary Branches together, and enters that of the Aorta, which comes first in Contact with the Spine under its left subclavian Branch; by which means it transfers more than Half the Blood to the descending Aorta, which must otherwise have passed through the left Auricle and Ventricle into the ascending Branches of the Aorta: And this is the Reason why the Aorta (in the Fœtus) is so small at its coming out from the Heart.

By this Mechanism, an Overcharge of the Blood is turned off from the Lungs, by directing a great Portion of that Fluid in a strait Course to the umbilical Arteries.

Dr. Chemineau has presented to the Royal Academy of Sciences of Paris, which he had repeated, concerning the Dispute, in those Days, about the Circulation of the Blood in the Fœtus between Mery and Littre, which this Heart had three Ventricles; viz. the right Ventricle receives as commonly the Vena Cava, but without the pulmonary Vein; the left Ventricle receives

alſo the pulmonary Vein, but not the Aorta; and theſe two Veſſels, the pulmonary Artery, and the Aorta, were implanted in the third ſupernumerary Ventricle.

The Apertures of theſe Veſſels were ſo depoſited, that the Blood of the right Ventriculus was expelled in the third, which takes its Courſe thro' the pulmonary Artery; and the Blood was alſo expelled in this Ventriculus by the left, and eaſily diffuſed itſelf into the Aorta.

There was no Ductus Arterioſus; the pulmonary Artery was very ſmall in raiſing from the third Ventricle, and divides itſelf into two Branches, each of which had double the Diameter of that of its Trunk; which ſeemed to demonſtrate, that the Blood comes out of the Heart to enter the Lungs, but ſo as not to be able to be admitted to remain; conſequently theſe Branches dilated them ſo.

If the Infant had lived, the Circulation of the Blood would have been peculiar in him; for the third Ventricle would always have remained: As the Blood had not yet Admittance into the pulmonary Artery, as uſual, it would have taken its old Courſe; therefore we ſhould have ſeen a Man ſomewhat like an amphibious Animal*.

Some Authors relate, that they have found Fœtuſes without Hearts; but I believe, that it is as rare, as what a certain Author tells us; viz. that he opened a Man, who was ſo emaciated, that the Heart was abſent in the Pericardium†.

CHESELDEN obſerves, that a Portion of the Blood before Birth, and not the Whole, is brought by the aſcending Cava to the right Auricle, paſſes at once through the Foramen Ovale into the left Ventricle with the Blood of the Deſcendens Cava,

* Vid. Hiſtoire de l'Academie Royale des Sciences, l'Ann. 1699.
† Vid. TILESIUS Rerum Naturalium, Lib. V. Cap. XXVIII.

and thence into the pulmonary Artery, where about one Half flows into the Lungs, and the other Half directly into the Aorta by the Ductus Arteriosus, which lies between the pulmonary Artery.

He supposes, that the Quantity of Blood that flows through the ascending Cava, in a given Time, to be as four; and that which flows through the Descendens Cava, to be as two: Then let two of the Quantity in the ascending Cava flow into the right Auricle, and it will then, with the two received from the Descendens Cava, have the Quantity four; which being thrown from the right Ventricle into the pulmonary Artery, the Quantity two is thrown into the Aorta by the Ductus Arteriosus, and the same Quantity into the Lungs by the pulmonary Branches; then the Quantity returning from them to the left Auricle, in the same Time, will be two; which being added to the two which flowed through the Foramen Ovale in the same Time, there will be constantly the same Proportion received into each Ventricle, at every Diastole of the Ventricles, as after Birth.

Now if the Blood flowing through the ascending Cava, joined by that from the umbilical Vein, was but equal to that flowing through the Descendens Cava; let each of them be called two, and let all the Blood of the Ascendens Cava go through the Foramen Ovale; then the Blood that the left Ventricle should receive, would exceed that which flows into the right, by the whole Quantity that flows from the Lungs in the same Time: But the Ascendens Cava conveying more Blood than the Descendens, the Excess in the left Ventricle would be yet greater.

If the Proportions which CHESELDEN has taken, for Ease in Calculation, were perfectly right, and he seems sure that they are nearly so; then

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the Quantity of Blood flowing into the left Ventricle would be to that flowing into the right, in the ſame Time, as five to two, if all the aſcending Blood went through the Foramen Ovale.

Though, after Birth, the left Ventricle of the Heart is only employed in throwing Blood into the Aorta, and the right wholly employed in circulating the Blood through the Lungs; yet, before Birth, all the Blood thrown out by the left Ventricle, and about Half the Blood thrown out of the right Ventricle, being thrown into the Aorta, and the other Part only through the Lungs; it follows, that the whole Force exerted by the left Ventricle, with about Half that of the right, is employed in throwing Blood into the Aorta, while that diſtributes Blood through the whole Fœtus, and to the Mother. But after the Birth, when the Blood is to be no longer carried from the Fœtus to the Mother, the left Ventricle becomes ſufficient for the Circulation through the Fœtus, and a new Occaſion immediately ariſes for that additional Power, which before was neceſſarily employed in throwing Blood into the Aorta; for the whole Maſs of Blood now being to be circulated through the Lungs, the Ductus Arterioſus cloſes, and the right Ventricle muſt throw all the Blood it receives into the Lungs, there being no longer any Paſſage into the Aorta.

It is ſuppoſed, that the Inflation of the Lungs, at the Birth, preſently alters the Condition of the Ductus Arterioſus, ſo as to obſtruct it; which Account is indeed mechanical, but, I think, not true; Becauſe I can neither diſcern that the Poſition of this Veſſel is altered, nor its Surface compreſſed. But I rather think, that, immediately upon the Breath, there being no Blood carried off from the Fœtus to the Mother, and the left Ventricle being ſufficient to fill the Aorta and its Branches with Blood,

Blood, as I have ſhewn before; there is no longer Room for any Blood to paſs from the right Ventricle; wherefore the Blood from the right Ventricle will be forced into the Lungs, where the Paſſage is now made eaſy, as I imagine, by their being inflated; and the Ductus Arterioſus, having the Blood no longer forced into it, ſhrinks, and, in Time, almoſt diſappears. This Duct being ſtopped, the Valve of the Foramen Ovale ſoon ſtops that Paſſage, it being on the Side of the left Auricle (or that muſcular Bag which is the largeſt Part of the Auricle), which being much the ſtrongeſt, the Valve muſt be preſſed more on that Side than the other by the Blood, in the Time of the Syſtole of the Auricle: And it is evident, that, in the Diaſtole of the Auricle, there muſt be more Preſſure to open that than the right, it being a ſtronger Muſcle; or elſe there could have been no Reaſon for having the left Auricle ſtronger than the right, in Proportion to their Ventricles.

Sometimes this Valve does not quite cover the Foramen; in which Caſe, a ſmall Quantity of Blood may poſſibly flow from the left Auricle to the right, and ſo circulate twice through the Lungs to once through the Body; but none could flow from the right to the left, and eſcape the Lungs, which might be of bad Conſequence.

Some have imagined that Men, who have this Paſſage open, cannot be drowned. But, though this Paſſage be ſometimes found open, no Man has been yet ſeen, that we have ever heard of, that could not be drowned.

I have ſeen the Foramen open in a Man that was hanged, to whom one might juſtly expect it ſhould have been as uſeful as in the Caſe of Submerſion in Water.

Many have ſuppoſed, that this Foramen is open in amphibious Animals, and in ſuch Fiſhes as have

two

two Auricles, two Ventricles, and Lungs like Animals, without Gills, which, in other Fiſh, are analogous to Lungs.

I have diſſected a Porpus, which is of this Kind, and found this Foramen cloſed; but the great Veins were vaſtly large, in Proportion to the Bulk of the Animal: Whence I conjectured, that the Blood was accumulated in their Veins while they kept under Water; and, by that means, the Lungs eſcaped being oppreſſed with Blood: Which Conjecture ſeemed to me the more probable, ſince all Animals, of this Kind, are not able to abide the leaſt Time under Water, when their Blood is moſt expanded with Heat.

But upon the Diſſection of an Otter, whoſe Foramen Ovale was alſo cloſed, I found the Veins nothing differing from thoſe of other Animals.

In a Water Tortoiſe, which I had an Opportunity of examining, with that moſt dextrous and indefatigable Anatomiſt Dr. Douglass, I found the two Ventricles of the Heart but half divided by a Septum; and in the Beginning of the pulmonary Artery ſeveral ſtrong muſcular Rings, at a little Diſtance from each other; each of which, by contracting, would be capable of reſiſting a Part of that Blood which otherwiſe would have been thrown into the Lungs, when they were under Water: And this Blood, ſo obſtructed, muſt neceſſarily be thrown into the Aorta; the two Ventricles being, in a manner, one common Cavity: And, when they are out of the Water, this Communication of Ventricles will ſuffer but little Confuſion of the Blood that flows into the Ventricles; becauſe each Ventricle receiving and diſcharging the ſame Quantity of Blood, at the ſame Time, they will balance each other; and thereby ſuch a Mixture will be very much prevented.

Monro obſerves, that the Water Tortoiſe has very large Lungs, conſiſting of larger Veſicles than Land Animals; and that they receive a greater Quantity of Air to furniſh that Je ne ſçai quoi, ſo neceſſary for the Life of Animals.

The ſame Thing I have obſerved in Frogs. Cheselden's Anatomy.

While Fœtuſes continue in Utero, their Muſcles commonly act only by their natural Contraction; but ſometimes, when the Eaſe of the Fœtus, or its Preſervation, requires a Change of Situation, it ſeems to perform ſome voluntary Motions called its Stirrings.

The Poſture of a Child is owing to the Muſcles being left to their natural Contractions; the ſtronger ones always prevailing, till their Antagoniſts exert ſuch a Reſiſtance, by being extended, as brings them to an Equilibrium. Hence the Spine is bowed forward; the Head bended towards the Knees; the Thighs are brought forwards; the Legs bended backwards; the Arms hang down, but are drawn a little forwards; the Fore-arms, Hands, and Fingers, are all bended; thereby the Hands are placed round the Knees. Monro's Medical Eſſays, Vol. II.

How far the Mouth, or the Umbilical Veſſels, are neceſſary to the Nouriſhment of Foetuſes*.

Several Fœtuſes, born without Mouths, being found, on Examination, to have another Paſſage from the Surface of their Bodies to their Stomachs, have induced Authors to aſſert the Univerſality of theſe vicarious Paſſages, and bring

* See Monro, in the Medical Eſſays, Vol. II,

that

that as an Argument for the Nutrition of Fœtuſes by the Mouth: But others have given accurate and well-vouched Hiſtories of Monſters that had no ſuch Paſſages.

Three Children*, a Whelp†, and a Lamb‖, were brought forth without Heads, or any Paſſage into the Chylopoïetic; others, with Hands, had no Paſſage to the Stomach‡: Some, who had a Paſſage into the Stomach, wanted Inteſtines**; and into the Inteſtines of others nothing could get down*†.

Theſe Examples ſhew the little Neceſſity there is for either Mouth, or chylopoïetic Organs, for the Nouriſhment of Fœtuſes: Yet ſome, who are of Opinion that it is conveyed by both the umbilical Veins and Mouth, ſay, that the Supply by the Navel may be wanting, as well as that by the Mouth; and therefore both contributing towards the Nouriſhment in the natural State of the Fœtus. Whenever one of them is wanting, the other performs the Function of both; as is ſometimes done in other Parts of the Body.

A more direct Proof (if it was true) of the umbilical Veſſels not being neceſſary, is offered, by two Examples of Fœtuſes that had no Navel-ſtrings.

The firſt we meet with in Vander WIEL's Obſervations, of a male Child, fifteen Months old, who was ſhewn at the Hague in the Year 1683. The Parents of the Child ſaid, when he was born,

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* LITTRE Memoires de la l'Acad. des Sciences 1701. MERY ibid. 1720. BUCHNERUS, Act. Med. Phyſic.

† DE GRAAF De Mulier. Organ. LITTRE Hiſtoire de l'Acad. des Sciences 1703. Philoſ. Tranſ. No 304.

‖ ANTOINE dans l'Hiſt. de l'Acad. des Sciences 1703. RUYSCH. Theſ.

‡ BELLINGER. de Fœt. Nutrit.

** LEMERY dans l'Hiſtoire de l'Acad. des Sciences 1704.

*† CALDER's Medical Eſſays, Vol. I.

there was not the leaſt Veſtige of the umbilical Veſſels, and the Navel was alſo wanting; but, in lieu of it, a broad, round, red Spot, as large as a Stiver Piece of Money, covered with a very thick Skin, appeared in the Hypogaſtrium, near the Oſſa Innominata; within the Circumference of which Spot two Papillulæ, or Aqueducts, were ſeen, at an Inch Diſtance from each other, by which the Urine was evacuated.

It ſeems very evident, that this Child was not really born without the umbilical Veſſels, as ſome Authors thought: What was, then, that red Spot! Nothing elſe but the Place of the Navel-ſtring, which, after it had dropped off, had cloſed up in this Manner. And as the Child's Friends were poor, they made it a Prodigy of Nature, to get Money by it.

Dr. MALCOLM FLEMING thinks he has proved, that the Fœtus is partly nouriſhed by the Mouth.

He ſays, as he was making an Experiment upon the Lungs of a ſtill-born Calf, it came into his Head to open the Inteſtinum Rectum, which was full of Scybales, or Balls, ſome of which he ſpread on a Piece of Paper, to examine at Leiſure, which he did two Days after, and found full of Hair, the ſame with that of the Calf.

He has made ſeveral other Experiments on this Subject; all which proved the ſame. So he concludes, that he had not met with Authors, before he made theſe Experiments, who had obſerved to have found Hair. As his Time is entirely taken up in Practice, he has not had Leiſure to read many, as he ſays; therefore he would have us be obliged to him for this important Diſcovery! as he termed it. But, ſince, ſome of his Friends have been ſo kind as to procure him Books which contain ſomething of the ſame Obſervation, &c*.

* See his Account in Philoſ. Tranſ. Vol. I. for the Year 1755.

I think we may safely conclude, with Professor MONRO, if, then, accurate Instances are recorded of Fœtuses being nourished without any Possibility of receiving Aliment by the Mouth, or into their chylopoïetic Organs; and if there is no distinct unexceptionable Proof of their being ever supplied with Nourishment without the umbilical Vessels; it necessarily follows, that the umbilical Vessels are absolutely necessary toward the Nutrition of the Fœtus; and that the Mouth is not so.

I shall refer my Reader to the Medical Essays, Vol. I. where MONRO has collected various Opinions, and, in short, whatever can be expected on so obscure a Subject.

OBSERVATIONS.

The Fœtuses sometimes unite, and form monstrous Bodies: Were there in the Ovum, or prolific Matter, monstrous Embryos? Or were these Monsters formed afterwards by a simple Union? by a Lusus Naturæ?

But, 1. It is certain, that the Imagination multiplies the Parts of the Fœtus in several Cases. There have been Examples, that Women with Child, after being struck with the Idea of a Monster, have brought forth Monsters. 2. We daily see Children wear the Marks of their Mothers Longings. 3. As Flesh joins; so, by divers Accidents, the two Embryos, when they appear nothing but a milky Substance, may be joined to one another.

There have been Philosophers, who would endeavour to explain the Effects of Imagination on the Fœtus: None but superficial Wits can give satisfactory Explications. We know nothing in the human Body but Matter and Motion. When a Mother is struck with some Object, the Motion increases in her Body, because of the Trouble that arises

arises in her Soul; this Motion cannot be communicated to the Fœtus but by these two Ways:

1. The Blood and Nerves of the Mother agitate the Womb; this Agitation causes divers Oscillations in the Vessels, or the Roots that fix the Placenta to the Womb; these Oscillations cannot but contract or dilate the Vessels: What will this Dilatation or Contraction produce? A Motion more or less rapid in the Fluids. But that Velocity, or Lentor, will be equal throughout all the Body; therefore one Part will not be more shaken than the other.

Let us even suppose, that Motion augments in one Part; can this Velocity only form a Part organised with all the Proportions, and like to that which strikes the Eye of the Mother?

We must either be very blind, or exceedingly clear-sighted, to conceive such a Phænomenon.

2. The Motion of the Mother may be communicated to the Fœtus by the Fluids that she sends thither.

But, 1. The Blood passes not from one to the other, as we have proved. There is but one Sort of Milk that enters into the Roots of the Placenta: We know how slow the Secretions are. Hence we may conclude, whether the Augmentation of the Motion can be considerable, if nothing but the Milk is the Production of it. 2. If even the Blood should flow from the Womb into the Fœtus, its Motion would be but very slow in the Ramifications of the Placenta; it would run a little swifter in the umbilical Vein, but in entering into the different Parts of the Fœtus, it prodigiously decreases.

Why, for Example, if carried with equal Swiftness to both Sides of the Head, shall it form an Excrescence on one Side, and not on the other? Why will it break the Legs or Arms of the Fœtus,

tus, becauſe its Mother had ſeen a Man broke upon the Wheel? Why will it form Figures of Animals that preſent themſelves to the Eyes of a Woman with Child?

Since we have ſeen, that there is no mechanic Law that can produce this Effect, let us ſee whether there is no other Cauſe.

1. If the Author of Nature had eſtabliſhed, that, at the Occaſions of the Motions and Imaginations of the Mother, it ſhould act on the Fœtus conformably to theſe Motions and Imaginations, this might be the Cauſe; but it is not general. There have been Women ſtruck with ſeveral Objects whoſe Impreſſions appeared not in the Fœtus. 2. If the Creator has eſtabliſhed theſe Laws, it is, in all Appearance, for other Reaſons; and this Effect muſt be looked upon as one of the Inconveniencies found in moſt Part of theſe general Laws, and which the Supreme Being did not judge à propos to make Exceptions againſt. 3. If we might conjecture, in a Matter of ſuch Obſcurity, I ſhould ſuſpect, that all this proceeded from plaſtic Natures, from which the Creator choſe to form Bodies that receive Souls. Theſe ſecondary Cauſes would act according to neceſſary Laws which the Creator had impoſed on them. As their Actions would not be voluntary, they would not act but according to the Circumſtances to which a ſupreme Law fixes their Action, then a violent Motion would be the Occaſion; according to which, that which gives Form to Matter would modify the Fœtus; that hinders me from laying it again immediately upon the Creator, becauſe they make him produce, without any Reaſon, a new organiſed Being.

This Inconvenience is not like that which follows the Laws of Gravity, for Example; whence a Motion, more or leſs violent, reſults on certain

Occaſions, that puts the Texture of Bodies out of Order: But here they introduce God working to form Beings of as difficult Productions as the beſt organiſed Bodies, and this without any Neceſſity. We might rather attribute this Work to depending Cauſes that were ordered to modify the Matter according to divers Circumſtances.

The Reſemblance of Children to their Parents may proceed from theſe plaſtic Natures which form the Viſage according to the ſprightly Imaginations of the Mother. We believe, that this Likeneſs is generally a reaſonable Foundation to attribute a Child to a Man; but that is not a Rule: The Cauſe, which is nothing but the Imagination that rules the Actions of the plaſtic Nature, ſhews that a Child may reſemble a Man who is not his Father: That which is moſt ſurpriſing is, that Children ſometimes reſemble their Grandfathers whom their Mothers never ſaw, and their Fathers have no Reſemblance of. In this Caſe, there is no other Reaſon to be given but the Ideas of plaſtic Nature.

But we may ſay, Children are like their Fathers and Mothers at the ſame Time, in ſuch a Manner, that the Features of the Mother are more obſervable than thoſe of the Father, will not appear: But a Mother, who will be more intent upon her own Features than upon thoſe of others, will tranſmit them to her Child; who, by that means, will reſemble his Grandfather.

Some Phyſiologiſts advance, that Men might be formed without the Semen's being received by the Woman. We have nothing to do, ſay they, but heat them by the Warmth of a Dunghill: But this is falſe. Thoſe who advance this Opinion, have neither Experience nor Reaſon on their Side: As if the Generation of our Species was like the Eggs of Hens, &c. We never can demonſtrate

ſtrate that the Semen can produce any Effect while it is not in the Reſervoir that Nature deſtined for it. If the Heat of a Dunghill could unfold the Embryo, could not the natural Heat unfold it better in Men, who retain their Semen a long Time? It would follow hence, that a Man would at laſt find himſelf with Child.

I know they have told us ſome Stories thereupon; but theſe are Tales that an Anatomiſt will never believe but by ocular Demonſtration, or unleſs authentic Witneſſes aver it.

Some Men, in their Writings, have advanced, that young Women have conceived without the Approach of the Male; but this ought alſo to be rejected: It is needleſs to refute ſuch abſurd Notions.

The Fœtus reſpires not; however, ſome Authors have oppoſed it. HIPPOCRATES ſays, that the Fœtus pumps Air through the Noſtrils and Mouth; and the great Mr. BOYLE brought ſome Proof to ſupport a Part of this Opinion, at leaſt.

The Fœtus, properly ſpeaking, reſpires not, according to his Opinion: Nevertheleſs, ſays he, as it appears, by our Experiments, that all Fluids contain Air; it will not be an abſurd Opinion to believe that the Fœtus, being ſomewhat grown, reſpires a little; ſince the ſuperior Part of the Amnios is emptied of its Fluid, and filled only with a vaporous Fluid.

He proves it by the Cries of the Child while as yet in the Womb, and the Noiſe of young Chickens which the Hen has not hatched.

SPON was perſuaded, by the ſame Reaſons, that the Fœtus reſpires in the laſt Months, but without any great Action of the Muſcles of the Thorax. The following are a few Reaſons to prove, that there is no Reſpiration in the Fœtus before its Enterance into the World.

1. The Diaphragm is extraordinarily rarefied. 2. The Lobes are flattened, and raiſed towards the external Part. 3. As ſoon as the Lungs have reſpired, they ſwim on the Surface of Water, and acquire a veſicular Form. But, 4. When they have not reſpired, they ſink to the Bottom when put in Water, and have not the Colour which the Air gives them when it has entered. 5. If there were any Air in the Lungs of the Fœtus, they would ſwell when put in the Air-pump; nevertheleſs this happens not, whatever Exactneſs be taken in pumping the Air: When they are taken out of that Machine, they ſink to the Bottom, as before. 6. In a Word, it is impoſſible that Reſpiration ſhould be performed with the ſmall Quantity of Air which is found in the Uterus. 7. That which was advanced about the Cries of the Fœtus before it appears, is abſolutely fabulous; the moſt that could be heard were Grumblings, cauſed by the Motion of the Waters, and Air of the Vagina or Inteſtines. What was ſaid concerning young Chickens, is no leſs falſe: We never hear them but when the Shell is broken. 8. Some Authors have aſſerted, that the Placenta performed the Part of the Lungs, and, by its means, the Mother furniſhed the Fœtus with Air neceſſary for Life. We cannot deny that there paſſes a little Air from the Mother to the Child: But does that prove Reſpiration in the Child itſelf? BERGERUS ſays, that the Fœtus has no need of Air to counterbalance the Preſſure of that which the Mother is environed with, becauſe it receives from the Mother a Portion of Lymph very much rarefied, which is enough agitated by the Æther. 9. The Motion of the Blood is very ſlow in Dogs, which are yet incloſed in theſe Waters. We ſcarce feel the Pulſation of the Heart; but when the Animals have once reſpired,

ſpired, the reciprocal Motions of the Thorax make the Blood flow with Rapidity.

Harvey delivers a Propoſition which is not eaſy to be ſolved. He aſks, How it is poſſible that a Fœtus, coming into the World without its Coverings of the Womb, can live long enough ſhut up in theſe Waters? And why it dies (when it has once reſpired) if Breath fails it?

1. Some have anſwered, That the Blood circulates no more through the Foramen Ovale, as ſoon as the Fœtus has reſpired. If this were ſo, it is evident, that as ſoon as the Fœtus received Air in the Lungs, it could have no more Life when it reſpired not.

Kerkering ſeems to confirm this Idea, when he ſays, that the Foramen Ovale is cloſed in the Fœtus reſpiring, by means of its Valvulæ. For the Blood, returning from the Lungs, fills the left Auricle, and applies the Valve to the Hole.

But if we examine this Anſwer with Attention, we ſhall ſee, that it cannot ſatisfy the exact Inquirer.

1. Experience teaches us, that the Foramen Ovale does not cloſe ſo ſoon: The Opening is ſeen, ſometimes, three or four Months after. There have been Subjects of grown Perſons who had their Foramen Ovale open.

2. In Inſpiration the Blood enters into the Lungs, and goes out by Expiration: According to this Opinion, when the Child wants Air, the Blood cannot circulate in the Lungs, ſince Inſpiration cannot be performed. Theſe Lungs emptied, tranſmitted their Blood to the left Auricle, which propelled it into the left Ventricle; thence it returns again into the right Auricle by the Vena Cava. Why cannot this Blood paſs through the Foramen Ovale, as when in the Womb?

3. The only Difference found in the Circulation of the Blood of the Fœtus is, that it is obliged to pass into the inferior Parts in larger Quantities; but this Difference cannot hinder the Circulation through the Foramen Ovale.

4. BERGERUS says, That the Fœtus is not exposed to the Pressure of the Air when it is in the Womb, and in its Waters; but if the Air touches it not immediately, it presses it as much by means of the Membranes and Water: Therefore this Reason is not sufficient. Besides, in case the Air should compress the Fœtus more out of its Membranes; I do not see that this ought to hinder Circulation through the Foramen Ovale. On the contrary, the Air, in pressing the Thorax, should reduce the Lungs to a small Extent, the same as before Respiration; therefore every Thing would be found in the Situation which was necessary for the Circulation of the Blood as before its Birth.

5. I know not how HARVEY made his Experiment: Perhaps he put a Fœtus, just born, into an Air-pump. If this was the Case, it would not be surprising that Death followed the Privation of the Air; for then the whole Machine is disordered by the Defect of the Equilibrium which is found between the internal and external Air.

If HARVEY stopped the Respiration of any Fœtus, and did it either in Inspiration or Expiration; if in Inspiration, we see that the Air, being stopped in the Lungs, will not permit the Blood to circulate, since it will with Vehemence enter the Lungs without being propelled there; if during Expiration, I see not how this Phænomenon may be explained. Perhaps we may say, that the Air, which is always in the Lungs, rarefies it so much, by its Heat, that it kills the Fœtus.

A certain Author mentions an Example of a Soldier who found a Womb in the Water, which inclosed a Fœtus still living in it.

LEC-

LECTURE XIX.

Of the GRAVID UTERUS, and the Excluſion of the FOETUS.

AS the Fœtus grows larger, ſo the Matrix increaſes proportionably; the ſerpentine Arteries, of which it is compoſed, being extended by the impelled Blood, and ſtretched into a more direct Courſe. Thus its Thickneſs continues the ſame; becauſe the great Quantity of Blood, which dilates the Arteries and Veins, makes up for the Extenuation of the ſolid cellular and fibrous Subſtances; and the Fundus, eſpecially, increaſes more than the reſt; ſo that, by dilating the above Tubes, theſe laſt ſeem thus to deſcend from the Middle of the Uterus, which, at preſent, by Degrees riſes from the Pelvis, even as high as the Stomach itſelf, ſo as to compreſs all the abdominal Viſcera, and more particularly the Bladder and Rectum.

During this whole Time of the uterine Geſtation, the Os Tincæ is never perfectly cloſed, and defended from the Air by a thick Mucus from the Sinuſes, nay, perhaps from the Veſicles which are ſituated in the Cervix of the Matrix, then being compreſſed, oozing out, more or leſs, their Contents; which make Women with Child always wet, more or leſs, as they complain. Therefore it is quite idle to imagine, with ſome Authors, that

this Mucus, or, as they call it, Corpus Luteum, glued up the Orifices of the Womb.

The Cervix of the Uterus itself yields to the Extension of its Body, so as to become exceeding short, and forming a broad flat Aperture, of no sensible Length; which, about the Time of Parturition, is always more relaxed.

The Fœtus, in the first Months, has no certain fixed Situation; but, being grown to a considerable Volume, is, about the Middle of the Time of Gestation, folded together in such a Manner, that its Head lies between the Knees; and, being the heaviest Part, it subsides, by Degrees, more and more towards the Cervix of the Uterus.

The increasing of the Fœtus excites, at first, uncommon Commotions, by which the Sides of the irritated Uterus endeavour to disengage themselves; and at length, towards the Conclusion of the ninth solar Month, when both the Weight and Restlessness of the Fœtus often thicken the Womb, become now intolerable. Its Head is, by the Reaction of the Uterus and Abdomen, impacted, somewhat like a Lump, into the Pelvis, so as to give the Mother great Uneasiness, as if a Quantity of Fæces was collected for Exclusion in the Rectum: In Consequence of which, Pain obliges her to strain, which facilitates and forwards the Delivery.

The Tenesmus thus increasing till it is no longer tolerable, the Mother uses all her Efforts by very deep Inspirations, which press the Uterus and Viscera downwards; and at the same Time the Uterus itself, by its contractile vital Force, now increased by the Stimulus, constringes itself so powerfully about the Fœtus, as sometimes to exclude it, without further Help from the Mother, &c.

Now

Now the Amnios, filled with the Waters, is first protruded vertically, before the Head of the Fœtus, so as to dilate the Os Internum Uteri; in which the Membranes, being by Degrees extenuated and dilated, easily break, and diffuse their Contents; which lubricate the Passage, and relax the Parts of the Vagina.

The Head of the Infant naturally presents itself with the Face to the Os Sacrum, being directed that Way by its Weight; and being urged forwards, somewhat like a Wedge, it further dilates the Os Uteri; till at length, by the more powerful Efforts of the Mother, the Head of the Child is thrust out through the distractile Vagina, with intolerable Pain generally to the Mother, and an universal Tremor of Body; and if none of the Bones of the Pelvis happen soon to press unequally, the Child easily advances, and is soon born.

The Uterus, which hitherto had been distended beyond Imagination, now contracts itself, by the elastic Power of its Fibres, so suddenly and powerfully, as often to catch and embarrass the Hand of the Deliverer; and sometimes retain the Placenta, if it be not soon loosened, and withdrawn.

By separating the Placenta from the Matrix, the uterine Vessels bleed, but are compressed no less than by the Elasticity of their own Tunics; whence a large Quantity of Blood, which was collected in the uterine Substance, flows out, and is named Lochia; at first a mere Gore, but afterwards its purple Colour changes, by Degrees, to that of a yellow Serum; and as the Openings of the Vessels contract themselves more, they at length become of a whitish or wheyish Colour; and then the ample Excoriation of the Uterus soon recovers a new Epithelium, or Cuticula, and shrinks up to a Bulk not much exceeding that of the primitive Volume.

Though

Though the Time of Delivery is pretty fixed, yet it may happen in one or more days, nay, in the same Woman at different Births; but it is always certain as to the Month; seeing it happens from the fifteenth Day of the ninth Month to the End, or thirtieth Day of the same. And though some Women assure us, that Delivery may happen sooner or later than the fixed Time we here mention; yet I suspect, very much, that they are wrong in their Reckonings, as not being exactly certain of the Time in which they conceive. For, that Nature should be uniform in her Functions, it is necessary that Woman should have her limited Time, as well as other Animals: Nevertheless, I am of Opinion, that several Circumstances may promote or retard the Delivery for some Days.

Authors are variously divided in respect to the Exclusion of the Fœtus. Some attribute it to the Collection of the Meconium, which irritates the Intestines of the Fœtus, and makes it struggle in the Uterus, and endeavour to get out of it: Others think, that it is the Acrimony and Irritation of its Urine in the Bladder: Others, again, will have it, that it is the Difficulty of the Uterus in yielding to the Volume of the Fœtus. It may be, probably, that the stimulating of the Meconium and Urine, the Smalness of the Matrix, with the Difficulty it has to dilate after a certain Extension, may contribute to the Exclusion of the Fœtus at the ordinary Term: But, however, I think we ought likewise to consider the Posture of the Fœtus.

We are to observe, that the Fœtus is in an Æquilibrium with the Water which surrounds it in the Membranes of the Placenta; its specific Gravity being the same with that of the Waters; it freely, without Constraint, floats therein, and is equally compressed on all Sides, the included Fluids

ids rendering the Compreſſion uniform and gentle; in lieu if the Fœtus lay dry in the Uterus, it would be continually ſubject to unequal Contractions of the Matrix and adjacent Parts.

In this State the Fœtus has its Head upwards, and Feet towards the Orifice of the Uterus, with the Face to the Mother's Abdomen: During the firſt ſix Months it commonly remains in this Situation, the Head being towards the Mother's Navel; for its Feet are, during that Time, ſpecifically heavier than the Head: But this Part begins, at length, to grow proportionably faſter than any other; wherefore its ſuperior Weight turns the Fœtus, with its Head downwards, to the Orifice of the Uterus.

This Change of its Situation is owing to the ſpeedy Growth of the Brain, &c. which generally happens about three Weeks or a Month before the Time of the Delivery, when Women ſay their Bellies are fallen, and find themſelves ſomewhat lighter, and more active, than before; but feel a greater Weight on the Orifice of the Uterus by the Compreſſion of the Fœtus's Head and Shoulders.

It may be demanded, What is it that diſpoſes the Orifice of the Uterus, with the Vagina and Vulva, to dilate themſelves, and give way to the propelled Fœtus; and what are the Vires, or Momenta, which exclude it?

1. We anſwer, That the conſtant Compreſſion of the Head againſt the internal Orifice of the Matrix gradually expands the infarcted Organs of the Veſſels, Vagina, &c. whence they become ædematous by the Stagnation of the Serum, which continually bathe and relax theſe Parts prodigiouſly, ſo that they may be conſiderably diſtended without any Laceration.

2. What

2. What are the Powers which exclude the Fœtus?

We anſwer, They are partly the various Strata of muſcular Fibres of the Uterus which conſtrict it, as every Midwife may be ſenſible of, when they depart the Placenta from the Matrix; at which Time we eaſily feel its Conſtriction*. Beſides, we are to add, that the abdominal, diaphragm Muſcles, &c. concur alſo for its Excluſion.

Some Authors have imagined, that the Oſſa Pubis yields, at the Time of Delivery: But I think they muſt never rightly conſider the Mechaniſm of their Ligaments, otherwiſe they certainly would not have thought ſo.

As for SAVIARD's having related that he heard the Bones of the Pelvis of a Woman crack; I am rather inclined to think that it was the Oſſa Femoris in the Acetabula.

The Fœtus in Utero, as we have obſerved before, has its Head, for about ſix Months, towards the Mother's Navel; that, by this Situation, the Placenta may the better adhere to the Matrix: Soon after, it is turned downwards; the Uterus is ſollicited, by its Weight, to yield, at the Orifice of this Organ, to the propelled Chorion and Amnios; which, with the Waters they contain, form a kind of ſmall Veſicula in the Orifice of the Uterus. This Protuberance ought not to be burſted too ſoon, but ſhould remain till the Woman is really in Labour: For if the Waters evacuate too early, the Delivery is generally the more difficult; as theſe Waters or Liquors facilitate the Excluſion of the Child.

* RUYSCH fancied that he had found a circular Muſcle in the Fundus of the Matrix, which he thought was for the Excluſion of the Fœtus,

Thus

Thus the Child gradually advances enlarging its Paſſage till it is excluded out of the Womb: When it is thus protruded into the Vagina to its Ears, it is ſaid to be in the Paſſage.

We ſhould not be ſurpriſed that the Infant ſhould ſo eaſily paſs where its Head did: For it is geometrically demonſtrated, that the Circumference of its Head is greater, or at leaſt as great, as that of its Shoulders. But this Proportion of the Head and Shoulders is obſerved only in Infants; wherefore, if the Child's Head once paſſes, the reſt ſoon follows; except a Miſconformation of its Shoulders be too large.

The Infant being thus in its Paſſage, if the Membranes ſhould not be lacerated, we ought to do it, in order to let out the Liquors, to lubricate the Parts, which facilitates the Delivery.

After the Child is born, and Navel-ſtring tied about two Fingers Breadth, the next is the Placenta, which uſually ſoon follows the Child; but if it ſtill adheres to the Uterus, the Midwife muſt diſengage it gently, without Violence.

We are now to obſerve the Symptoms which follow Parturition.

The firſt and chief is, a ſanguine Evacuation, or kind of Hæmorrhage, proceeding from the parting the Placenta from the Appendices Cæci, or Sinuſes of the Uterus, which are, at this Time, very large, and turgid with Blood; whence the Flux is ſometimes very conſiderable, but ſeldom dangerous. On the contrary, if it be ſtopped before the uterine Veſſels are evacuated, it is always of bad Conſequence to the Woman.

This Evacuation is named Lochia, laſts ſometimes only about an Hour, and retains a ſanguineous Colour for three or four Days, ſometimes only two. This ſanguineous Evacuation gradually grows of a higher Colour, and about the End

of

of ten or twelve Days the Flux is generally purely lacteal; and, laſtly, lymphatic: However, this varies, according to the Temperament, Climate, and other Circumſtances.

Dr. ASTRUC ſays, he has ſeen ſome Women who have had the Lochia for ſix Weeks, or not over till the Menſtrua appeared.

While they flow, and paſs through the different Degrees already obſerved, the Uterus and Appendices Venoſæ are contracted in the ſame Proportion; and the Colatoria Lactea, which compreſſed them, are alſo evacuated*.

Preternatural Births are occaſioned by the Situation of the Child in the Time of Labour, oppoſite to what we have before obſerved.

The firſt is, when his Feet, either ſeparately or jointly, preſent themſelves firſt to View. In this Caſe, the Midwife ſhould obſerve if there are not more than one Infant in the Womb, for fear of taking hold of a Foot or Hand of each of them. Whatſoever Parts the Child preſents for Birth, except its Head, we call preternatural, which are attended with great Difficulty in delivering the Woman of a live Child: However, we ought always to uſe our utmoſt Endeavours to procure a

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* When the Time of Delivery approaches, the Orifices of the Matrix begin gradually to dilate. The Midwife ought to introduce the Fingers into the Vagina, to know the State of the Uterus, and the Poſture of the Child; whether it be his Head, Hand, Foot, Placenta, &c. which preſents itſelf for the Birth; which Parts are eaſily diſtinguiſhed by expert Midwives; and to take Care not to miſtake the Protuberance of the Membranes of the Fœtus with the Waters, for the ſoft Part of his Body.

The Child may be in its natural Situation for Birth, yet cannot be delivered; occaſioned either by Miſconformation, or a Collection of the Oſſa Ilia within the Sacrum, or from the Enormity of the Child itſelf, &c.

☞ I intend not here to give a Syſtem of Midwifery, as that Subject properly belongs to the Practice of Surgery; which, if theſe Lectures be generouſly received by the Britiſh Tyros in Anatomy, I may hereafter publiſh another Courſe of Lectures upon the Theory and Practice of Surgery.

natural Birth firſt. As for the Uſe of a Forceps, Fellets, or Crotchets, I reject them; the beſt Thing is the Hand, for the Delivery of a Child alive. In Fact, I am inclined to think, that the Author or Inventor of the Forceps, &c. contrived them to ſupply the Deficiency or Enormity of his Hands; which I farther think is very unkind to the fair Sex, to attempt helping them at the very Time when they generally find their Burden too large for the Parts, without adding a clumſy Hand. Therefore Women ſhould examine the Hand of the Midwife ſhe intends to employ.

I ſhall here take the Opportunity to recommend one of the beſt Eſſays which has been wrote in the Engliſh Language, by the ingenious Dr. JOHN BURTON of York. I have not the Pleaſure of being acquainted with the Author; therefore the Public cannot accuſe me of being partial: For there are other Books, of this Kind, wrote by Authors of Fame, perhaps, in London, which are quite defective.

OBSERVATIONS.

A LACERATION OF THE UTERUS*.

The frequent ſudden Deaths of Women in Child-bed are often very afflicting to whole Families. In moſt Caſes of that Kind, an Hæmorrhage has been blamed, and perhaps not always without Reaſon: But I have diſcovered Cauſes of it, which are ſtill more inſuperable.

On the Firſt of July 1747. there was brought to the Theatre a Woman who was delivered after a very hard Labour, attended with cold Sweats. I diſſected her about Half an Hour after her Death,

* Extracted from HALLER's Opuſcula Pathologia.

and

and found a large Hole in the left Side of the Neck of the Womb, both in the Cervix itſelf, and in the Peritonæum, which connects the Uterus to the Vagina. The Cervix was full of confuſed Valves, the Uterus itſelf almoſt ſcirrhous, very thick, and though thinner at the Interval between the Fallopian Tubes than elſewhere, yet even there it was a full Inch in Thickneſs, and had a great Number of white tranſverſe Fibres. In the middle Space above the Cervix, the Uterus was almoſt two Inches thick, compact, and full of ſmall Orifices of Arteries. That Part to which the Placenta had been fixed, had a great many little Portions of the Chorion adhering to it: The Adheſion of the Placenta had been circular between the Fallopian Tubes, which went off below the Middle of the Uterus, and were pendulous, as uſual.

One of the Ovaria was quite ſound; in the other a ſmall Foramen appeared, together with a vaſcular pellucid Tumor. From the Foramen went a pellucid Vein, not very ſmall; and an Inciſion being made in the Tumor, it appeared to be a Corpus Luteum, ſpherical, ſeparable from the Ovarium, yellow, vaſcular, furrowed, and cluſtered like a Bunch of Grapes, without any Fovea. Under it were Veſſels of a pretty large Size, and in the ſame Ovarium there were likewiſe other ſmall Ova, as they are called.

In the Cervix of the Uterus, a little above its Orifice, were a great many large, oblique, mucous Sinuſes. The inferior Duct, ſituated near the Middle of the Vagina, was about an Inch long, and without any Gland.

The anterior Rugæ of the Vagina were ſound, and the Sinuſes at the Urethra full of Mucus. The internal Membrane of the Uterus was thin, ſmooth, adhering very firmly, and here and there porous.

porous. Under it was an immenſe Number of Veins, which were very turgid.

The fleſhy Subſtance of the Uterus was full of Chinks, unequal, lobular, conglomerated as it were, and of a white Colour.

The Uterus itſelf, properly ſo called, was of a globular Figure.

II.

On the Fourth of September 1748, another healthy Woman died in Child-bed. The Uterus was near five Inches long, and as many broad, flattened both before and behind, extended a little above the Margin of the Os Pubis, and covered the Bladder. A little below the Cornua of the ſuperior Part of the Uterus, not far from the Middle, came out the Fallopian Tubes; and the Convexity of the Uterus between the two Tubes did not exceed that of a Woman who is not pregnant. Having injected it with Wax, I perceived a Hole in the Uterus on the right Side of the Orifice. Upon farther Examination, the ſpongy Fleſh at the Orifice of the Uterus was found degenerated into a great Number of grumous, very thin, reticular Membranes, without the leaſt Appearance of the Ring which is commonly found there. In the ſame State was the contiguous Part of the Vagina; and where its Texture was not quite deſtroyed, it conſiſted of Fibres and cellular Membranes cohering weakly together, and variouſly interſected. The upper Part of the Vagina was very much dilated, but not ſo as the inferior. In the ſpongy Part of the Uterus it was thickeſt, but at its Bottom it did not exceed ſix or eight Lines. Inſtead of Sinuſes, I obſerved a kind of ſmooth cylindrical Veins, full of Ramifications. The Ligaments were alſo of an unuſual Thickneſs.

III.

On the Eighth of November 1748, I diſſected a young Woman who had taken ſome ſtrong Purgatives, in order to procure a Miſcarriage, and died in Convulſions within fifteen Minutes after ſhe was delivered.

The ſpermatic Veſſels, as VESALIUS formerly obſerved, were an Inch thick; the Uterus was raiſed a few Inches above the Pelvis, collapſed, firm, pulpy, and thick.

The Cervix of the Uterus was torn, and thro' the lacerated Part, the Head of the Fœtus had paſſed, about an Inch above the Pudendum. In the ſound Part the Rugæ had ſcarce ſuffered any Alteration, the internal Part of the Orifice of the Uterus was wide open, appeared to be lacerated, was thin, flocculent, and about two Inches broad. The Inſide of the Uterus was full of Blood, which being waſhed off, there appeared a great many white, ragged, flocky Subſtances, as if the Texture of the Uterus had been converted into Wool. More internally, I obſerved a Number of very thin membranous Lamellæ, an Inch or more in Breadth, which conſiſted of the Chorion, ſo grown to the Uterus as to put on the Appearance of its internal Membrane.

In the Subſtance of the Uterus, which was more than ſix Lines thick, there were a great many Orifices of Veins, into which Air being blown, it paſſed, in the Form of Bubbles, through Orifices of different Sizes, ſome being pretty large, and others very ſmall, into the Cavity of the Uterus.

The muſcular Fibres were red, broad, diſpoſed into Lamellæ, very numerous, and in various Directions. It was hardly poſſible to reduce them into Order; ſome of them deſcending to the Orifice of the Uterus, ſome ſurrounding it tranſverſly,

and

and many of these last immersed, as it were, in the former, which they exceeded, both in Number and Size.

The Valves of the Neck of the Uterus were slender, at a considerable Distance from each other full of very small Pores and Lacunæ.

The Tubæ Fallopianæ, which were very long, and the round Ligament came out of the Fundus of the Uterus. This last was sent off long before POUPART's Ligament, and terminated in vascular Filaments.

In the Ovarium there was a Fissure, and a pellucid Corpus Luteum, not exactly hemispherical, of a reddish-yellow Colour, and hollow. The Cavity was Half a Line broad, not deep, but very vascular at its Bottom; and besides there were pretty large Ova, about two Lines broad, contained in the same Ovarium. Wherefore the Ova are not consumed by the Corpus Luteum.

* In the two Uteri, where the Neck of the Womb was lacerated, the Side of the Neck was burst, which seemed to be owing to the oblique Situation of the Fœtus at the Time of Birth; for it is probable, that its Head did not present itself directly against the Orifice of the Uterus, but pressed against the Side or Neck of it; and thus the Vessels of the Neck being pressed, the Circulation of the Blood through them was obstructed. Hence the Veins, which at that Time were both very large and thin, easily burst; and the Blood, being poured out both from them and the Arteries into the adjacent cellular Substance, a Swelling was produced, with a Suggilation, Softness, and a kind of Mortification in the Neck of the Womb. And, lastly, by repeated Efforts of the Head, not directly against the Orifice of the

* Ad Disp. JOACH. VOSSE, 1749.

Womb, but the Sides of the Orifice, the Neck came to be lacerated.

These Things appear to me to be so evident, as not to require any Demonstration.

This oblique Posture of the Fœtus, to which I impute the bursting of the Uterus, has been represented by FLEURY and DEVENTER; Fig. 37, 38.; but, as far as I remember, without taking any Notice of the fatal Event which I think is to be apprehended from it.

MULLER, who likewise met with a Case of the same Kind, has given a more full Account of it in his Diss. qua Casus rarissimus uteri in Partu rupti sistitur. Basil. 1745.

In Relation I. of a Woman, out of whose Womb a Child had been newly taken, I said, that the rugeous Ring of the Vagina was not obliterated; and the Case was the same in another Body, the IIId, which induces me to conclude, that these Rugæ are either quickly restored, even within a few Minutes after Delivery, which seems scarce probable; or that they are not entirely designed for the more easy Extension of the Vagina by their Dilatability.

In Women who have died in Labour, I have always seen Processes of the Chorion so intimately connected with the Uterus, and so perfectly resembling it, that there seems no manner of doubt of something being transmitted that way to the Fœtus by the Uterus. On this Occasion, however, I must not omit mentioning, that this very Winter I saw in a Fœtus, that had been injected by the umbilical Vessels, a pretty large Artery filled with Wax; and its Branches dispansed.

RUYSCH Epist. XIII. p. 10. NOORTWYCH De Uter. grav. p. 14. and several others, have denied the Existence of any red Vessels, capable of being injected, in the human Amnios.

Lastly,

Laſtly, It is certain, as I have elſewhere obſerved, that as theſe Villi of the Placenta are almoſt inviſible, ſo the Orifices of the Veins of the Uterus, which open between the muſcular Bands of Fibres, are very large: But this does not hinder leſſer Veins likewiſe from opening into the Cavity of the Womb; and even theſe are very large, when compared with the Villi of the Placenta, as Profeſſor MONRO has juſtly remarked, in his Medical Eſſays, Vol. II. p. 134.

Wherefore it appears, that many ſmall Arteries of the Placenta open into one ſingle Vein of the Uterus.

After I had publiſhed my Commentary upon BOERHAAVE, I found in three Bodies, where the Uterus was burſt, and in other pregnant Uteri, that the Tubes are very little affected by Pregnancy; and that the Part of the Uterus between the Tubes is not much increaſed, and but a little convex: But as in pregnant Women the Tubes are almoſt pendulous, and therefore parallel with the Uterus; hence it ſeems to have happened, that DEVENTER, Lum. Obſtet. p. 400. and other anatomical Writers, have made the Tubes, during that State, to go out a long Way below the upper Part of the Uterus.

Dr. PARSONS * likewiſe obſerves, that there can be no ſuch Thing as Superfœtation; becauſe, in pregnant Women, the Tubes come out below the Fundus of the Uterus, and cannot reach to the Ovaria.

But theſe Aſſertions are diſproved by many Experiments, which have lately been made.

For it is certain, that Superfœtations do happen. And in pregnant Women I have ſeen the Tubes of ſuch a Length, as to be capable of reaching the Ovaria very eaſily.

* See him, on Muſcular Motion.

The Corpora Lutea I have so frequently met with in Women, that I now look upon it as nothing uncommon; yet I shall add a few Remarks upon this Subject.

1. I never saw two Corporæ Luteæ in one Woman. 2. I never saw a Corpus Luteum where the Woman was not pregnant, or even for any considerable while before the Time of Labour; and, consequently, never before Puberty: All which is very different from the Doctrine of VALISNERIUS, and others.

The Corpus Luteum does not consume all the Ova; for I have seen great Numbers of them along with the Corpus, contrary to what several Authors have asserted, particularly BOERHAAVE.

In the human Fœtus, and indeed before the Age of Puberty, I have never met with any Ovula; the Ovaria, before that Age, being long, narrow, flat, without any Prominences, and in their Figure and dry Texture very different from those of adult Females.

These Truths invalidate the Observations of VALISNERIUS, and some other Authors of Reputation, who describe the Ova even in Fœtuses and new-born Animals, as if they had really seen them.

Those Women who expire after a very hard Labour, oppressed with Faintings, cold Sweats, and excessive Weakness; for the most Part do not owe their Death so much to the violent Hæmorrhage (which I do not believe to be so suddenly mortal, from the Examples of Persons who have been wounded), but rather to a Laceration of the Uterus. For in those who have had that Part wounded from different Causes, as has appeared after their Death, I have observed the very same Symptoms to happen, as in those who too often are carried off within Half an Hour after Delivery:

But

But whether the Raſhneſs or Unſkilfulneſs of Midwives, or incurable Diſeaſes, prove fatal to the Patients, the Grave, for the moſt Part, prevents our diſcovering.

In Women who have died of acute and ſpotted Fevers, I have often ſeen the Blood ooze ſpontaneouſly out of the Mouth; and this has given Birth to the Story of Vampyres, which lately made ſo much Noiſe all over Europe, and was firſt propagated by ſome imperial Troops quartered in Hungary; viz. Perſons who had died of acute Diſeaſes, and eſpecially Women who had periſhed in Child bed, and been haſtily buried, as is uſual in hot Climates, were found, upon opening the Graves, with their Mouths foaming with Blood. The other Particulars were the Fruits of Imagination.

The firſt Account I meet with, of this epidemical Superſtition, is in ANTHONY GALATHEUS.

The Cauſe appears to me to be no other than the Expanſion of the elaſtic Air contained in the Lungs, which forces upwards the Blood with which that Viſcus is overcharged towards the End of thoſe fatal Diſeaſes, from the broken ſmall Veſſels, reſembling, in ſome meaſure, the foaming of fermenting Liquors.

This morbid State of the Uterus and Vagina ſhews, that theſe Parts conſiſt of a common Membrane: For nothing can more reſemble the common cellular Structure than the lacerated and mortified Fibres of thoſe that have no certain Direction, nor any conſiderable Length; but, on the contrary, are ſhort, and interwoven with one another in all Directions.

The ſame Structure alſo obtains in the Tendons, as appears from thoſe of the ſlender Kind; for Example, that of the plantaris or palamaris Muſcle, the Expanſion of which forms a Membrane

reſembling that which in the Bladder or Stomach is called nervous, and which ALBINUS has demonſtrated to be of that Kind.

The Sinuſes of the Uterus were communicated in Comm. BOERH. as well as ſeveral other Obſervations, by Perſons of diſtinguiſhed Reputation. Theſe, after repeated Experiments, which at that Time were but few, I claſſed among the Veins in ſome Eſſays ſince publiſhed; and this Opinion I have ſince confirmed by five or ſix late Diſſections of Women who had died in Child-bed. For they are continued with the Veins, branched like them, and ſubdivided into ſmaller Ramifications, and, laſtly, evidently ſheathed in that thin tender Membrane which covers the Veins.

The Cauſe of the inaccurate Deſcription formerly given of theſe Sinuſes, ſeems to be owing to their large Size, unequal and eaſily-extended Diameters, and the unaccountable Largeneſs of their Orifices opening into the Cavity of the Uterus. By injecting the Veins with Wax, Models are formed of theſe Sinuſes; but they are very irregular, as is uſual in the Veins; and here the more ſo, the farther the Veſſels recede from the natural State of the pregnant Uterus. Neither is that extraordinary Dilatation obſerved to take place equally in all Parts of the Uterus.

But whether the Sinuſes which MALPIGHI has deſcribed, in the Uterus of a Cow, are of the ſame Kind with theſe, or rather, whether they are true Sinuſes; I ſhall not yet take upon me to determine.

The Laceration of the Vagina I attribute to the Want of Dexterity in a Midwife; who, in order to extract the Fœtus, had forcibly thruſt both Hands up the Vagina: For it could not be owing to the Fœtus alone in its Paſſage; ſeeing every Body knows how eaſily it makes the reſt of its Way,

Way, as soon as it has passed the internal Orifice of the Uterus.

Most Authors have alledged, that the Orifice of the Uterus becomes thinner in the Time of Labour; but it is only to be understood in this Sense; viz. the thick and annular Portion of the Uterus, which is produced into the Vagina, the larger the Opening of the Orifice is, the more it resembles Part of the Uterus; and both the Prominence of the Uterus into the Vagina, and the circumscribed circular Furrow between the Part of the Vagina and the circular Production of the Uterus disappear at the same Time.

These Remarks I have thought proper to add to Note V. p. 389. Comm. BOERH. Tom. V.

I have frequently seen the muscular Fibres of the Uterus in Women who have died in Childbed, but never more beautiful than in this Subject of which I now write. There is no doubt but RUYSCH saw the same, and called them the Muscle of the Uterus. They are true Laminæ of parallel muscular Fibres, lying upon one another in different Directions, which I never have been able to reduce to any regular Order. Between these Fibres are a great many Interstices, both large and small, of no determined Figure, opening into the Cavity of the Uterus; and these are the Orifices of the absorbent Veins of the Uterus, at this Time dilated to their largest Diameter. So that what I said before, concerning the Fibres of the Uterus, seems now sufficiently confirmed; and it is the same Thing to me, whether they are termed muscular Fibres, or a Muscle.

Thus most anatomical Authors speak of the muscular Tunic of the Bladder: H. FABRICIUS, COWPER, Drs. DOUGLAS and PARSONS, have looked on it as the Detrusor Muscle.

I the more readily quote this Inſtance, from having obſerved a very great Affinity between the Fibres of the Uterus about the Time of Labour and thoſe of the Bladder. But that the Delivery of the Remains of the Placenta may be effected by theſe Fibres, is a Point juſtly queſtioned: For it is very certain, that Clots of extravaſated Blood, though they are looſe, and evidently leſs compact than the Placenta, are frequently confined in the Womb, and condenſed into fibrous Maſſes, which ſometimes at laſt adhere to the Sides of the conſtricted Uterus: And I have often found the Chorion, ſeveral Months after Pregnancy, grown firmly to the Uterus.

By what Mechaniſm theſe Fibres can expel the Placenta, when it adheres to the Uterus, I cannot conceive: Though I am far from denying, that when it floats looſe in it, they may be capable of forcing it out, in the ſame Manner as they do Clots of extravaſated Blood.

The above Obſervations are taken from HALLER's Opuſcula Pathologica Sectiones Cadaverum Morboſorum, &c.

LECTURE XX.

Of the MAMMÆ.

THE Name of Mammæ, or Breasts, is given to two Eminences, more or less round, situated in the anterior and a little towards the lateral Parts of the Thorax; their Center, or middle Part, lying almost opposite to the osseous Extremity of the sixth true Rib, on each Side. Their Size and Figure vary in the different Sexes and Ages.

In Children of both Sexes, and in Males of all Ages, they are commonly no more than cutaneous Tubercles, or soft Verrucæ, of a reddish Colour, called Papillæ, or Nipples, each of them being surrounded by a small, thin, and pretty broad Circle, or Disk, more or less of a browniſh Colour, and an uneven Surface, termed Areola.

In Females arrived at the Age of Puberty, which is sometimes sooner, sometimes later, a third Part is joined to the two former, which is a convex Protuberance, more or less round, of about five or six Fingers in Breadth; the Papilla and Areola being situated near the Middle of its convex Surface. This is what is properly termed Mamma; and it may be termed the Body of the Breast, when compared with the other two Parts. It increases with Age, and is very large in Women with Child, and those which suckle Children: In old Age it de-

decreaſes, and becomes flabby, loſing its natural Conſiſtence and Solidity.

The Body of the Mammæ is partly glandular, and partly compoſed of Fat; or it is a glandular Subſtance mixed with Portions of the Membrana Adipoſa, the cellulous Pelliculæ of which ſupport a great many Blood-Veſſels, Lymphatics, and ſerous or lactiferous Ducts, together with ſmall glandular Moleculæ which depend on the former; all of them being cloſely ſurrounded by two Membranes continued from the Pelliculæ.

The interior of theſe two Membranes, which is, in a Manner, the Baſis of the Body of the Mamma, is thick and almoſt flat, adhering to the Muſculus Pectoralis Major. The ſecond or external Membrane is thinner, forming a particular Integument for the Body of the Mamma, more or leſs convex, and adhering cloſely to the Skin.

The Corpus Adipoſum of the Mamma, in particular, is a ſpongy Cluſter, more or leſs interlarded with Fat, or a Collection of membranous Pelliculæ, which, by the particular Diſpoſition of their external Sides, form a kind of Membrane ſhaped like a Bag, in which all the reſt of the Corpus Adipoſum is contained. The anterior or external Portion of this Bag, or that which touches the Skin, is very thin; but that Side next the Pectoralis Major is thick.

The glandular Body contains a white Maſs, which is merely a Collection of membranous Ducts, narrow at their Origin, broad in the Middle, and contract again as they approach the Papilla, near which they form a kind of Circle of Communication. They are named Ductus Lactiferi.

The coloured Circle, already mentioned, is formed by the Skin, the inner Surface of which ſuſtains a great Number of ſmall glandular Moleculæ, of that Kind which Morgagni calls Glandulæ

dulæ Sebaceæ. They appear very plainly all over the Areola, even externally, where they form little flat Eminences, at different Distances, quite round the Circle.

These Tubercles are perforated by small Apertures, through which a kind of sebaceous Matter, more or less fluid, may be squeezed out. Sometimes this is a serous Liquor, sometimes a milky Serum, and sometimes pure Milk, especially in Nurses; and I have seen both serous and milky Drops come out at the same Time.

From whence I am inclined to think, that these Apertures communicate with the lactiferous Ducts; and that the Tubercles are a kind of auxiliary Papillæ added to the true ones. The different Liquors which may be squeezed from the same glandular Body, give also room to think, that the Foramina in them communicate, by their Extremities, with several other smaller ones.

The Tubercle which lies in the Center of the Areola is termed Papilla, or the Nipple. It is of different Sizes in different Ages and Constitutions, and in the different Conditions of Females in particular. In Women with Child, or who suckle, it is pretty large, and generally longer or higher than it is thick or broad; and when it happens to be short, it causes great Uneasiness to the Child.

The Texture of the Nipple is spongy, elastic, and liable to divers Changes of Consistence; being sometimes harder, sometimes more flaccid. It seems to be composed chiefly of ligamentary Fasciculi, the Extremities of which form the Basis and Apex of the Nipple. These Fasciculi appear to be gently folded or curled throughout their whole Length: And if, by drawing the Fibres out, these Folds be destroyed, they return again, as soon as that Action ceases.

Between

Between these spongy and elastic Fasciculi lie seven or eight particular Tubes, at small Distances from each other, and all in the same Direction: These Tubes end at the Basis of the Papilla in the irregular Circle of Communication of the lactiferous Ducts, and at the Apex, in the same Number of almost imperceptible Orifices; and as they are closely united to the elastic Fasciculi, they are folded in the same Manner with them.

The Body of the Papilla is covered by a thin cutaneous Production, and by the Epidermis. Its external Surface is uneven, being full of small Tubercles and Wrinkles; among which, those near the Circumference of the Nipple seem to have a transverse or annular Disposition, which, however, is not uniform.

This Disposition, or Direction, seems to be owing to the elastic Folds already mentioned; and from this simple Structure it is easy to explain how Infants in sucking the Nipple, and Women in drawing the Teats of Cows, bring out the Milk. For the excretory Tubes, being wrinkled in the same Manner as the Fasciculi, do, by these Wrinkles or Folds, as by so many Valves, hinder the Milk, contained in the Ducts, from flowing out; but when the Nipple is drawn and elongated, the Tubes lose their Folds, and the Passage becomes streight. Besides this, when they are drawn with a considerable Force, the whole Body of the Mamma is increased in Length, and contracted in Breadth, and thereby the Milk is pressed into the open Tubes; and thus, by barely pressing the Body of the Breast, the Milk may be forced towards the Nipple, and even through the Tubes.

The Arteries and Veins distributed through the Mammæ, are Ramifications of the Arteriæ and Venæ Mammariæ; of which, one Kind comes from the Subclaviæ, and are named Mammariæ Internæ; the

the others from the Axillares, called Mammariæ Externæ.

These Vessels communicate with each other, with those near them, and with the Vasa Epigastrica, as was observed in the Description of the Arteries and Veins. The Nerves come chiefly from the Costales, and, by means of these, communicate with the great Nervi Sympathetici.

Of the Formation of the Milk.

The Antients imagined, that Milk is secerned from the very Blood; but most of the Moderns, with more Reason, think, that it is derived from the Chyle: Nor are there any immediate Vessels, whereby it is conveyed from the thoracic Duct, yet discovered belonging to the Breasts; but is deposited in those Organs by the sanguine Arteries. The Chyle, thus elaborated, is conveyed to the Vesiculæ Mammæ somewhat like the uterine Lactea. The Vessels are disposed in the same Manner in the Breasts; where the Ducts, rising from the Vesiculæ, are called Vasa Galactifera; all which meet in seven or eight large Trunks, which terminate in so many Orifices in the Nipples of the Mamma. From each of the said Vesiculæ arises a lymphatic Vessel which ascends to the axillary Glands, where all these mammillary Lymphatics terminate. Hence, in all painful Distensions of the Breast from the Milk, &c. the Patient feels a Pain in the Axillæ: and hence Obstructions of the axillary Glands, in most Cancers.

In Girls, of about ten or twelve Years of Age, the mammary Lymphatics are very small; so they receive no Fluid but a thin Lymph, which is returned into the Blood by the Way of the axillary Glands, as above; not being spissid enough to remain in the Breasts.

But

But young Women, about the Age of fifteen or ſixteen Years, grow not ſo ſpeedily as before; whence they form ſuperfluous Chyle; which, by Degrees, procures itſelf a little Paſſage into their Breaſts: Wherefore the ſmall Quantity of it, mixed with the Lymph of the Breaſts, renders it more ſpiſſid, and leſs permeable, than before. For which Reaſon, Part of it is retained in their Breaſts, which yield a Humour ſomewhat like the Milk; which, by its Spiſſitude, was incapable of circulating in the ſmall Ducts of the axillary Glands. Hence the Breaſts then grow conſiderably, and are termed Maturæ Viro.

Next to theſe are pregnant Women, who, from the Compreſſion of the Uterus, and the Retention of their ſuperfluous Blood, have ſtill larger Breaſts, and more Milk, as well in thoſe Organs, as in the Uterus: One providently inſtituted by Nature to nouriſh the Infant, whilſt in the Womb; the other, in its Turn, to feed it, when born. And this is frequently obſerved in the Breaſts, even a little Time after Conception.

Laſtly, Women newly delivered have, for two or three Days, flat, depreſſed, and empty Breaſts, through the Derivation of the Milk along with the Floodings; but, when theſe are once ſtopped, the Breaſts ſoon grow turgid, and they contain much more genuine Milk than any of the former: So that, from the Diſtenſion of their Breaſts, their Senſibility, and the continual Efforts of the Milk, now derived to thoſe Organs, the Febris Lactea ſprings, whence immediately enſue Diſorders of the Breaſts.

Of the Febris Lactea.

This Fever, as well as the milky Abſceſſes of the Breaſts, are Diſorders, likewiſe, reducible to thoſe

thoſe which immediately follow Delivery. This Diſorder ſometimes happens on the fourth Day after the Birth. It is ſubject to ſeveral Varieties: Some never have it, at leaſt have it very moderately. Its Manner of beginning and ending is alſo various: It is commonly preceded by and attended with Tenſion, Swelling and Pain in the Breaſts, which Symptoms frequently extend themſelves to the Axilla: It generally terminates by abundant Sweats, which are the more copious, as the Fever, cold Fits, or Rigours, were greater. Theſe Rigours happen commonly about the third Day after an irregular Manner; then the above Symptoms appear. The Pain in the Arm-pits is ſometimes ſo violent, that the Patient is obliged to hold up her Hand continually; in which Caſe, the Fever is generally violent.

Women, after their firſt Birth, are commonly more ſubject to this Fever than any other, through the Compactneſs, and, as it were, Impermeability of the Veſſels both of the Matrix and Mammæ; but when theſe Parts are once ſufficiently dilated to receive or exonerate their reſpective Humours, ſhe ſuffers little or no Fever: At moſt, it holds no longer than twenty-four or thirty Hours, in others only ſix; the Pain and Tumour of the Breaſts, &c. vaniſhing along with it.

Others, on the contrary, eſpecially ſuch as we mentioned before, have an acute Fever, with Redoublements, for four Days. Nor is it only terminated by Sweats, but may be alſo by Vomiting, or reaching to do it; Reſtoration of the Lochia, Diarrhœa, &c.

The true Cauſe or Origin of this Fever is as follows:

We have obſerved before, of the Veſiculæ Lacteæ of the Matrix and Breaſts, how, by the Contraction of the former Organ, the Lochia are

ſtopped; whence the milky Liquor ariſes in the Breaſts, which have a ſtrict Affinity with the Uterus. At the Reflux of this Fluid to the Mammæ, of ſoft, pendulous, and flaccid, as they were before, they become, by Degrees, tenſe, painful, and turgid; and that in Proportion to the Quantity of Milk returned into the Blood: Whence the various Degrees of the Fever evidently appear, as alſo from the Quality of the Milk. For if it be ſweet, balſamic, and in a moderate Quantity, it will make no great Impreſſion on the Solids, nor Change in the Blood. Conſequently, little or no Fever, nor other Symptoms, will ſupervene. But if the Milk be abundant, ſwells the Breaſts, ſtagnates in their Subſtance, and thereby becomes acid and corroſive, or is naturally aceſcent in Proportion as it is returned into the Blood; it kindles a Fever, preceded by irregular cold Fits; both being violent, according to the Degree of Acidity, and Quantity of the Milk: For theſe Rigours never happen if the Milk be not more or leſs acid; which inſpiſſates the Blood, and produces cold Fits.

The Breaſts, during this State, are not much tumified through the Spiſſitude of the Liquor, whereby they cannot enter the ſmall Veſſels of the Mammæ; whence the Breaſts are pendulous and ſoft, during that Time: But as ſoon as the Blood is divided and attenuated by the Fever, they begin to ſwell, and the Fever ends in profuſe Sweats. If to the great Quantity of Milk, with the preceding Quality is added a large Quantity of Crudities in the Primæ Viæ and other Emunctories, as we obſerve frequently in ſuch as eat too much about the Time of their Delivery, or were accuſtomed to Gluttony, &c. the Fever will not only be ſo much the more violent, but even putrid, and likewiſe ſubject to Exacerbations, &c.

Thoſe

Thoſe Women who ſuckle, are ſubject to a Diſorder called Morbus Pilaris, which is an unequal Tumor of the Breaſts, attended with Heat, Tenſion, and Redneſs, commonly preceded by ſhivering or cold Fits; to which ſucceeds a Febris Ephemera, which frequently terminates in thirty-ſix Hours, and very often gives Leave to Suppuration and Abſceſs of the Breaſts, &c.

This Diſorder has received various Names.

Some ſay that it was called, by ARISTOTLE, Morbus Peloris; becauſe he imagined that the Nurſe ſwallowed Hair. Others named it θρομβωσις, or θυρωσις; in Latin, Caſeatio; and Engliſh, Curdling of Milk.

If we conſider the Beginning and Progreſs of this Diſorder, we may eaſily diſcover, that it takes its Riſe from ſtagnant Milk lodged in the Veſiculæ Mammæ: For the Character of the incipient Diſorder makes this evident, by the Tenſion and unequal Tumor of the Breaſts; which, in this Circumſtance, cannot ſpring from any other Source than the Milk, which thus obſtructs ſeveral Cluſters, like Bunches of Grapes, of the ſaid Veſiculæ; becauſe their common Duct, or Vas Galactiferum, through the different Cauſes, to be immediately explained, cannot exonerate the Milk of theſe united Receptacles. Theſe Cluſters are more or leſs numerous, according to the Number of the obſtructed Vaſa Galactifera.

That the ſtagnant Milk is the principal Cauſe of this Diſorder, is alſo proved by the Diminution or entire Removal of the Evil when this Milk is ſucked; nor will any other Remedies be ſo efficacious for its Cure.

The Cauſes which inſpiſſate the Milk are,

1. Sudden Cold, in which the Breaſts are ſometimes unwiſely expoſed to the Air. 2. But this is ſtill more; viz. the depraved Quality of the Wo-

man's Aliments, and her Indigeſtion; whereby a vicious Chyle is formed; which, by its Mixture with the Blood, &c. inſpiſſates the whole Fluids of the animal Oeconomy. 3. The Change of Diet. Thus a Nurſe, accuſtomed to a ſlender Diet, by feeding on ſucculent nutritious Aliments, yields ſpiſſid Milk. This is the Reaſon why ſome Nurſes, after changing their accuſtomed Manner of Living, as when they come into a Gentleman's Family, or from the Country to Town, frequently their Milk turns bad, though before it was exceeding good.

We may add here an Infinity of other Cauſes: As when the Nurſe neglects to ſuckle the Child at proper Intervals of Time; when the Milk remains too long in the Breaſts, or the Child happens to be too weak to ſuck Milk enough; and it may proceed from the ill State of Health of the Nurſe.

For if ſhe be young and healthy, ſhe will, conſequently, make more Milk than the Child is able to conſume; ſo the Remainder will gradually accumulate in the Breaſts, and produce Inflammations, Abſceſſes, Ulcers, &c.

1. Redundant Milk, which ſo diſtends the Veſiculæ of the Breaſts, that they obſtruct and ſtrangulate the Orifices of all the adjacent Vaſa Abſorbentia, which ſerve, in Reſolution, to return the ſtagnant Humours. This is very frequent in the Febris Lactea and Morbus Pilaris.

2. The Spiſſitude of the Milk; whence it cannot circulate in the ſmall Veſſels which ſhould abſorb it. But however they at any Time receive but its moſt fluid Particles, the reſt remaining in the Veſiculæ, till, by Degrees, it is hardened; and then forms a Scirrhus, if it does not produce an Inflammation.

3. The

3. The Acrimony of the Milk, where it ſtimulates the Veſſels, excites their convulſive Contraction, gives Room to the Stagnation of the Blood, and to Inflammation.

Now if Reſolution be once prevented, and Inflammation formed and continued, that towards the End the Symptoms of Inflammation become more intenſe, as the Tenſion, Pain, Heat, Redneſs, &c. it denotes a Rarefaction of the included Humours, and that Suppuration is at Hand. The Swelling of the Breaſts, to this Pitch, ſo compreſs the large arterial Branches, that the Perſon ſenſibly feels their pulſative Motion: The Suppuration being formed, the Rarefaction of the Matter is diminiſhed, the tumefied Part becomes flaccid, and ſubſides, and all the forementioned Symptoms ceaſe.

But we are to obſerve, that, of all Suppurations, none are ſo ſlow, and imperceptible, as that of the milky Tumors, or ſuch as are formed of a Mixture of Blood and Milk; for this Matter is ſo ſweet and balſamic, that it hardly irritates the Veſſels; and, for want of a corroſive Acrimony, it is not ſubject to gain far into the adjacent Parts: The Pus is, moreover, extremely white. But in purely ſanguine Inflammations, the ſtagnant Humour is ſo charged with Salts, that its Progreſs is ſpeedier, it ſtimulates the Veſſels, excites their Oſcillations, has an acrid Quality, fuſes at a great Diſtance, and is of a grey Colour; wherefore milky Abſceſſes are much more ſupportable: So that ſome Patients bear them, for a long Time, without any manifeſt Danger; whilſt the Abſceſſes of ſanguine Inflammations, beſides the above Symptoms, frequently kill the Patients; likewiſe by ſlow Fevers, and other Symptoms ariſing from the Abſorption of the corroſive Pus. Yet, when the milky Pus remains a long Time included in its

Cyſta, it diſtends its Capſula in ſeveral Apices of the Breaſt, renders it thinner, and raiſes a great many Elevations.

This Diſorder is rarely mortal; but it is very painful, through the Senſibility of the membranous Texture of the Breaſts: It is alſo very tedious, and difficult to be cured; becauſe the enſuing Ulcer is commonly ſordid, and can never be well deterged, through the Sponginefs of the Breaſt.

In ſhort, it may be very dangerous if it terminates in a Scirrhus, or Cancer, through the Induration of the ſtagnant Matter. Dr. Astruc.

Various Conjectures on the Formation of the Milk, &c.

Nature has not freed the Breaſts from her Luſus. Women generally have but two; but Blasius has remarked three in one Woman; Walæus and Borrichius obſerved the ſame. Thomas Bartholine gives an Account of a Woman who had four; another Anatomiſt has made the ſame Obſervation. As for their Bulk, they are monſtrous in ſome Countries: At the Cape of Good Hope the Women have their Breaſts ſo long, that, it is ſaid, they throw them over their Shoulders.

After having ſeen the Structure of the Breaſts, we muſt mention ſomething of their Uſe; which is, to ſeparate the Milk from the Maſs of Blood.

The firſt Queſtion to be aſked is, What the Nature of the Milk (which comes from the Breaſt) is?

1. Here is what is diſcovered by the Help of the Microſcope. I feign would examine, ſays Lewenhoeck, what Matter the Blood is formed from; and I obſerved, that it is compoſed of ſmall red Globules that ſwim in a clear Fluid: I alſo diſcovered, that the Milk was nothing but a Cluſter of ſmall Globules that ſwam in a diapha-

nous

nous Fluid; but the Globules of the Blood differ from thoſe of Milk in their being of an equal Bigneſs, which thoſe of the Milk are not; ſome being ſmall, others large, of an irregular and ſomewhat globular Figure.

By the Analyſis we thought to diſcover the Nature of Milk; but we by that ſhall never gain the Point. Fire changes Bodies, ſince it diſcompoſes them: It cannot, therefore, give us the true Principles of Bodies.

Thoſe who reaſon on the Nature of Milk, according to the Analyſis, have no more Reaſon than thoſe who would know the natural State of Pebbles by Lime.

It will then be aſked, Whether the Milk is an Acid, or an Alkali? It is neither one, nor the other. The acid Salts that are ſeparated from the Aliments are inſinuated in the animal and vegetable Earths, or rather in their Alkalies. In this Mixture it cannot have an Acid or Alkali; a middling Salt will be only produced: Add to this, that Oil changes theſe Salts greatly.

Milk is nothing but a true Chyle, but has a leſs Serum. It is ſomewhat more triturated by the Heat of the Blood, Motion of the Heart, and Reſort of the Veſſels. Cheeſe, Cream, and Butter, may be made of it. It coagulates not on the Fire, as the Serum of Blood; that only which exhales leaves a thickiſh Subſtance at the Bottom.

1. It has a leſs Serum; becauſe that which is found in the Chyle divides into the whole Maſs of Blood: It muſt therefore have but a Part of it in the Milk.

2. The Milk was more triturated, ſince it paſſed the Heart, and moſt of the Veſſels.

3. We may make Cheeſe of it, which we cannot do in the Chyle; becauſe the Oil is not ſepa-

rated enough from the Phlegm, and mixed with the Matter that forms the Basis of the Salt of the Blood.

4. It coagulates not as the Serum of the Blood; because that has passed through many secretory Ducts, when it has passed through them. The most aqueous Part flows into the Filtres and lymphatic Vessels; the oily Part, therefore, gathers in greater Quantity; then it mixes not so well with the Water. If exposed on the Fire, what happens? The Particles of Fire act on these oily Parts concentered; their Action expresses the Water that remained there: The oily Parts, therefore, must gather together, and form a more solid Whole. The same happens not to the Chyle; because the Oil was not concentered enough in passing through the Strainers and natural Heat.

5. Milk alkalises in Fevers; it changes Colour. It has been sometimes observed to become yellow from Night till the next Day: This Colour is given the Milk when we boil it with Alkalies. The Heat which is excited in the Blood by Fevers produces the same Effect. Thus we see that animal Substances are less proper to afford good Milk than Vegetables: For the Parts of Animals are more alkalised and disposed to Putrefaction.

The second Question to be examined is, Whether the Milk comes from the Blood immediately, or whether it be nothing but a Chyle brought to the Breasts by particular Ways? The Antients said, that it proceeded, in some measure, from the menstrual Blood. Coringius advanced, that it was produced by the Blood which became not perfectly red. Barbatus believed, that it proceeded from the Serum of the Blood. Malpighi said, that Fat could produce Milk. Entius, Deusingius, and Everard, form it from the Chyle.

Wharton

Wharton is of the same Opinion; but he adds the nervous Juice to it.

The Antients knew but the Arteries and Veins, and therefore sought for no other Vessels to carry the Milk to the Breasts. The Knowledge which they wanted, says Needham, hindered them from erring; but, after Assellius's Discovery of the lacteal Veins, they began to seek for Canals which might immediately carry the Chyle into the Breasts. Everarc says, that, having dissected a Bitch that was with Young, and gave suck, he observed chylous Canals which crept by the Muscles of the Abdomen upon the Fat, and were inserted in the glandular Texture of the Breasts; but this Discovery was not confirmed by any Anatomist: There is therefore more Appearance that there are no milky Canals, and that the Chyle comes from the Blood in the Breasts. The Ducts are not necessary; for the Chyle may be carried through the sanguinary Vessels.

1. We have seen Examples which prove that the Milk may issue out through an infinite Number of Places; as the Thigh, &c. It is certain, therefore, that nothing can carry that milky Juice there but the Blood.

2. Injections prove, that there is a continued Way from the Arteries to the milky Ducts. This Continuation of Canals can be of no other Use than the discharging the Arteries.

3. What could be objected is, that the Blood might change the Chyle: But here follows a solid Answer of Lower.

The Chyle, says he, mixed with the Blood, leaves not its Whiteness immediately: On the contrary, it circulates a long Time with the Blood before it loses its Colour. We have nothing else to do but to open the Vein of an Animal four or five Hours after it has eat much, and we shall see

a great deal of Chyle ſwimming on the coagulated Blood: This Chyle is like the Milk. I have made the ſame Experiment on Men who were let Blood after a full Dinner or Breakfaſt: The Veſſel rather ſeemed full of Milk than Blood.

Manget obſerved a perfect clear Chyle come from the Noſe of a Man who had loſt a great Quantity of Blood in an Hæmorrhage.

The third Queſtion is,

How the Milk filtrates, and is ſucked by the Child? The Blood, filled with Chyle, is carried into the Arteries of the Breaſt: By the Mechaniſm of Secretions, which we have already explained, the Blood is too thick to paſs through the ſecretory Ducts; but the Milk, whoſe Mollicles are not ſo thick, according to Lewenhoeck, immediately inſinuate there: From theſe Strainers iſſue out Lymphatics; by the Preſſure of the Blood and Membranes the aqueous Part is inſinuated, ſo that the Milk has leſs Phlegm; this Milk, carried into the Follicles and Ducts, is propelled by the Blood found in the ſpongeous Texture with which the milky Canals are environed, and of which the Nipple is formed: The Ducts which receive the filtrated Milk are very numerous, and grow wider towards their middle Part; they can therefore contain a large Quantity of Fluid: When the Diſtenſion of the Veſſels will ſurmount the Oppreſſion of the Nipple, the Milk will flow voluntarily; the Mechaniſm by which the Infant cauſes the Milk to come to it.

Steno, in his Treatiſe on the Glands, ſays, that Nature gave Nerves to the parotid Glands (which very much reſemble the glandular Bodies of the Breaſts): Thus, according to the Action of Imagination and Will, the Saliva may flow from its Reſervoirs. When the Nerves are about to act, ſays he, they ſtreighten the Veſſels through which

the

the Saliva might flow, and oblige it to iſſue out.

What Steno ſays of the Parotids, on the Subject of Nerves, may be ſaid of the Breaſts. They are covered by an infinite Number of nervous Fibres which form Papillæ on the Nipples, as obſerved by Ruysch; theſe Papillæ, being irritated by ſucking, ſtreighten the capillary Veſſels that retake the Blood from the ſpongeous Texture; thus the Blood, which is always propelled through the Arteries, accumulates there, and preſſes the milky Tubes; which, by that Preſſure, pour out the Milk.

There is ſtill another Cauſe that obliges the Milk to iſſue out. The Infant pumps the Air in ſucking; thus the Milk ought to iſſue out with an Impetuoſity proportionable to the Force with which the Air is pumped. If, by a ſudden Inſpiration, all the Space of the Mouth were found void of Air, in ſuch a Manner that that Fluid could not enter there any other Way; the Milk would run with great Force; as we may ſee, when we ſuck a Fluid with a glaſs Tube: Then the Lacteals are extremely preſſed by their Number, at the Places where their Inoſculations are found with the external Ducts, and by that Preſſure obſtruct the Paſſage of the Milk; theſe Veſſels, I ſay, compreſſed by the Force of the external Air, throw the Milk into the Infant's Mouth.

The fourth Queſtion to be aſked is, Why Men have not Breaſts? We may anſwer to this, That they are of no Uſe to them. Nature immediately formed the Parts that were neceſſary for the Conſervation of the Species: Though theſe Parts are unuſual in one Sex, ſtill that Sex is not entirely deprived of them, unleſs that Deprivation be a neceſſary Conſequence of the Structure that makes the Sexes to differ.

If

If what Travellers ſay, that Men nouriſh their own Children, be true, we could not then ſay, that the Breaſts were entirely uſeleſs.

Venetius gives us an Example of a Man whoſe Breaſts contained a vaſt Quantity of Milk. Theophilus Bonetius, in his Sepulchretum Anatomicum, p. 163. gives us many of the like Stories. The Men, of whom theſe Authors ſpeak, might, without doubt, nouriſh an Infant, if their Breaſts were ſucked. But it will be ſaid, Why have not Men Milk, as well as Women?

Nathaniel Highmore anſwers, That the glandular Bodies which are found in the Breaſts of Women are not found in thoſe of Men, or that they there appear dry. The Breaſts, ſays he, are very prominent in fat and effeminate Men; but their Figure and Subſtance diſtinguiſh them from thoſe of Women.

Aristotle, with Reaſon, ſays, that the Subſtance of the Breaſts of Women is fungous; and that it was depreſſed, and dry, in thoſe of Men.

Theſe Reaſons of Aristotle and Highmore do not reach to the primary Cauſe: It would be neceſſary that they explain why the Breaſts are more dry in Men, than in Women.

1. In Infants, of either Sex, the Breaſts are very much inflated, and generally contain ſome Milk. It muſt be ſo, ſince the Organs are the ſame; and that there is no more Tranſpiration on one Side than on the other, while the Fœtus is in Utero, and during its Infancy.

2. As ſoon as young Women are arrived to a certain Age, and that they have their Menſes, then the Veſſels of the Breaſt, which are very flexible, dilate: From theſe Veſſels there always paſſes a Fluid into the lacteal Follicles; the turgid Arteries alone cannot produce the Tumor that riſes there, and this Fluid repaſſes in the Veins or Arteries.

teries. Perhaps we may ſuſtain, that it is in the Arteries it runs back again: For theſe Canals, being compreſſed by the Texture of the Breaſts, which is very firm, and the Reſort of the ſmall Veſſels, the Fluid may return in the Arteries: But it is probable, alſo, that there may be Canals to bring them back into the Veins. The Swelling we have been ſpeaking of, happens in Proportion as young Women approach the Age of thirteen or fourteen Years: Then it is perceived, eſpecially ſome Days before the menſtrual Flux. The Blood, which fills the uterine Veſſels in an extraordinary Manner, hinders that which follows from entering the Blood which flows in greater Quantity into the Arteries, which from the Abdomen communicates with the Breaſts, and hence the Breaſts ſwell. As ſoon as the ſecretory Ducts of the Uterus begin to open, the Blood paſſes no more in ſo great a Quantity through the Arteries communicating with the Breaſts; the Blood, which ſwelled the Breaſts, circulates by Degrees, and the Fluid ſeparated from it, preſſed by the mammillary Texture, re-enters the Courſe of Circulation by Degrees; the Breaſts muſt then be evacuated, as we have already ſaid.

3. Thus we ſee, that the ſame Reaſon which proves no menſtrual Flux in Man, proves, that the Milk ought not to filtrate in their Breaſts. As they have no Plethora, the mammillary Veſſels, which are never ſwelled, do not dilate: On the contrary, as they fortify and harden, the Follicles and milky Ducts acquire a Hardneſs, becauſe they are membranous; and thus the Blood would not be able to ſeparate the Milk, when there ſhould even at laſt happen a Plethora, as we often ſee by periodic Fluxes, which are performed through the hæmorrhoïdal Veſſels.

4. We

4. We may, nevertheleſs, ſee Men, in whom a Plethora, large mammillary Canals, a Preſſure, or Sucking, would produce Milk. All this depends upon the Dilatation of the Canals.

The fifth Queſtion worthy our Notice is, Why Women, after Child-bed, have Milk? The Mechaniſm only of the Motion of the Parts in Child-bed Women may anſwer this Queſtion. Thoſe who were not of the ſame Opinion have ſaid nothing but Abſurdities.

Deusingius believed, that the menſtrual Blood contracted a certain Quality which rarefies the Blood, and there forms a Diſpoſition to change into Milk. He adds, that the Fœtus, compreſſing the Pancreas and Stomach, propels the Chyle towards the Breaſts. But this laſt Opinion would prove, that the Milk ſhould be formed during the Pregnancy, and terminate after Delivery.

Diemerbroeck, not ſatisfied with that Explanation, ſays, it is nothing but Imagination that determines the Milk towards the Breaſts. He brings many Examples to prove that Opinion: But there is more Imagination in the Opinion of that Anatomiſt, than in the Cauſe that gives Child-bed Women their Milk. Likely, according to him, that Goats, which have Milk, though they have not been with Young, have a very great Force of Imagination; ſince they have it long before Women.

Bayle, Profeſſor of Philoſophy at Tholouſe, is every-where for Fermentations. He attributes the Origin of Milk to Fermentation. I will not enter into the whole Explication, which is unworthy of ſo great a Man. We may aſk his Followers,

1. Whence proceeds this Fermentation?
2. How it is produced in the Breaſts?
3. What is its Nature?

If they have but Poſſibilities, or Imaginations, they are not worthy to be heard.

To

To comprehend the Cauſe that propels the Milk into the Breaſts after Child-bed, we muſt recal,

1. That the Milk proceeds from the Chyle.

2. That the Veſſels of the Uterus are extremely dilated during Pregnancy.

3. That the Uterus contracts immediately after Delivery.

4. That there paſſed a great Quantity of Chyle, or milky Matter, into the Fœtus.

From the third Propoſition, 1. It follows, That the Blood being no more able to enter, in ſo great a Quantity, into the deſcending Aorta, will mount, in greater Quantities, in the aſcending Arteries; and, conſequently, thoſe Arteries which come from the Subclavian and Axilian into the Breaſts, will be more turgid.

2. It follows, from that ſame Propoſition, that the Blood which enters into the deſcending Aorta, being no longer able to be inſinuated, in ſo great a Quantity, into the Uterus, will fill the epigaſtric Arteries more which communicate with the Breaſts: The Breaſts then muſt be more inflated, on both Sides, after Delivery.

3. From the fourth Propoſition it follows, That the ſuperfluous Chyle of the Nouriſhment of the Mother, which paſſed in the Fœtus, muſt divide, to flow into other Veſſels; and, conſequently, be carried to the Breaſts. At the firſt Circulation that will be performed, there will come one Part; at the ſecond another, &c. and at five or ſix Hours after eating, the Chyle is not yet changed into Blood: The numerous Circulations, which will be performed during that Time, will there carry the greateſt Part of that Chyle which would have paſſed in the Fœtus, if it were ſtill in the Womb. Whilſt the Chyle is thus carried to the Breaſts, the Follicles fill in an extraordinary Manner, and the inflated Ducts are very much com-

compreſſed; and at the Place where they inoſculate this Preſſure hinders the Milk from overflowing: The Ducts, which were not, as yet, open, contribute alſo, by their ſtreight Cavity, to hinder this overflowing; but, as ſoon as the Breaſts are ſucked, 1. The external Ducts dilate. 2. The Cylinders of Milk, which are in the internal Ducts, are contiguous to the Cylinders that entered the Externals: The Milk, therefore, which flowed not before, will ſpout out, after we have once ſucked thoſe Ducts which were empty of Milk; by the ſame Reaſon that the Urethra is ſometimes empty of Urine through the too great Dilatation of the Bladder; which, being too much inflated, thruſts its Neck again into its Cavity, as we have before explained it. 3. By the ſame Reaſon that Milk is filtrated in the Breaſts of Lying-in Women, it may alſo be filtrated in thoſe of Virgins whoſe Menſtrua are ſuppreſſed. For the Blood, not being able either to circulate freely, or iſſue out thro' the Womb, will be propelled in the Breaſts, as it often happens. Hence we ſee, that this may happen to Women in Years, whoſe Menſes are at an End. Nevertheleſs, as the Fibres are dried by Age, this will not happen in aged Women, whoſe Parts are dry.

The ſixth Queſtion to be aſked is, Whence ariſe the different Properties obſerved in Milk?

1. The Milk grows ſour, which happens not to other Fluids that ariſe from the Blood. This Sourneſs proceeds from nothing but the Acids ſeparating from the alkaline Earth and their Oil, which happens not to the other Fluids, becauſe the Heat has more ſtrongly united their Principles, and diſpoſed them more to Alkali than Acid.

2. Milk has the Virtue, Taſte, and Smell, of the Aliments; becauſe the Particles of Matter, with which we are nouriſhed, paſs into the Blood

without being diſcompoſed, and enter into the Breaſts without having ſuffered hardly any Change; as appears by the Experiment of LOWER.

Thus if the Aliment be good, the Milk will be good; if it is bad, the Milk will be ſo too; eſpecially if we have faſted long: For then it cannot be mixed with any other Matter that might give it ſome Alteration.

Some Hours after Meals, as it has circulated, it will be proper to form good Milk: If it was too acid, the Heat will then have changed it, and will be more diſpoſed to become alkali; if it be too much alkaliſed, the alkaline or too much heated Part will precipitate by the Urine, becauſe it becomes more viſcous, as we may ſee by the Urine. If a Nurſe faſts twenty four Hours, the Chyle will alkaliſe, and thus will form a yellow ſaltiſh Milk, diſpoſed to putrefy. Phyſ. Eſſays.

OBSERVATIONS.

It is a Matter of Diſpute, among ſome Surgeons, Whether cancerous Tumors ſhould ever be extirpated, or not? Though it is certain, none of theſe ever were cured without; and, being extirpated, there have been many.

The Objection againſt Extirpation is this: That the Operation often provokes the Part, which otherwiſe might lie quiet. But I do not think this is true. In deſperate Caſes, where we cannot extirpate, we find the beſt Remedy is plentiful Bleeding (which alſo is Nature's laſt Reſort), gentle conſtant Evacuations by Stool, and a Vegetable Diet. And though Phyſic never cures while the Tumor remains; yet, after Extirpation, it is highly uſeful, and even the worſt Conſtitutions have ſometimes been brought to their primitive State.

An eminent Surgeon in the City, having a Patient with a cancerated Breaſt, extremely large, and ſo much ulcerated, that the Stench of it was inſupportable; ſhe inſiſted upon the Extirpation, againſt all Advice, with no other Hopes but to be delivered from the offenſive Smell. Some Time after the Operation, the Wound looking extremely ſordid, he ſprinkled it all over with red Mercury Precipitate, which put the Patient into a high Salivation; upon which, the Breaſt grew clean, and healed; the Patient recovered, and, contrary to all Expectation, lived many Years in good Health.

From this Accident I learned the Uſefulneſs of ſalivating after extirpating cancerous Tumors, though nothing is more hurtful before.

In the Extirpation of a Breaſt, and all other Tumors, as much Skin as is poſſible ſhould be ſaved; for the Loſs of a great deal of Skin is enough to make an incurable Ulcer in the moſt healthful Body, and much more ſo in a bad Conſtitution. CHESELDEN's Anatomy.

LECTURE XXI.

Of the PLEURA, HEART, and its Appendages.

THE Pleura is a Membrane which adheres closely to the internal Surface of the Ribs, Sternum, the Intercostal, Subcostal, Sternocostal Muscles, and to the convex Surface of the Diaphragm. It is of a very compact Texture, somewhat like the Peritonæum; being furnished with Plenty of sanguineous Vessels; and likewise in that it is composed of an internal membranous Lamina, and a cellular Substance on the external Side, which is a Production or Continuation of the Lamina.

The cellular Portion surrounds the internal Surface of the Thorax, but the membranous Portion is disposed in a different Manner. Each Side of the Thorax has its particular Pleura entirely distinct from the other, and forming, as it were, two great Bladders, situated laterally, with respect to each other, in the great Cavity of the Thorax, in such a Manner, as to form a double Septum, or Partition, running between the Vertebræ and the Sternum; their other Sides adhering to the Ribs and Diaphragm.

This particular Duplicature of the two Pleuræ is named Mediastinum: The two Laminæ, of

which it is compoſed, are cloſely united together near the Sternum and Vertebræ; but in the Middle, towards the inferior Portion of the anterior Part, they are ſeparated by the Pericardium and Heart. A little poſteriorly they are divided, in a tubular Form, by the Oeſophagus, which is inveſted by it; and in the poſterior Part a triangular Space is left between the Vertebræ and two Pleuræ, from the ſuperior to the inferior, which is filled chiefly by the Aorta.

Before the Heart, from the Pericardium to the Sternum, the two Laminæ adhere very cloſely, and there the Mediaſtinum is tranſparent, except for a ſmall Space near the ſuperior Part, where the Thymus is ſituated; ſo that, in this Place, there is naturally no Interſtice or particular Cavity. The apparent Separation is owing entirely to the common Method of raiſing the Sternum, as was plainly demonſtrated by BARTHOLINUS, in his Treatiſe of the Diaphragm publiſhed at Paris in 1676.

The Mediaſtinum does not commonly terminate along the Middle of the internal Side of the Sternum, as the common Opinion has been. WINSLOW has demonſtrated (in the Year 1715, to

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LIEUTAUD obſerves, that the Pleura does not always lie more on the left Side; and ſays, that ſometimes it lies on the right, ſometimes it divides the Thorax exactly in the Middle.

HEISTER maintains, that there is a Space left between the two Pleuræ, and it is imaginary. Wherefore, to ſupport his Argument, he relates, that many Authors of Credit give us Inſtances of Abſceſſes formed therein; and MAIER (in his Colleg. Pract.) affirms, that he has frequently found a ſerous Humour in it.

But the ſerous Humour, or Pus, that I found in Children and Adults, under the Sternum, as well as between the Pleura and Ribs, is no Argument that, in the natural State, there is a Diviſion. It is very well known, that, in an inflammatory Fever, or Pleuriſy, the cellular Membrane of the Thorax is ſometimes ſo much inflamed, that it is more than Half an Inch thick, full of Serum, and which turns into Pus. However, the cellular Membrane of the Pleura is more looſe under the Sternum, than towards the Ribs.

the

the Academy of Sciences), that ſuperiorly downwards it inclines towards the left Side; and that if, before the Thorax is opened, a ſharp Inſtrument be run through the Middle of the Sternum, there will be almoſt the Breadth of a Finger between the Inſtrument and the Mediaſtinum; provided that the Sternum remain in its natural Situation, and the Cartilages of the Ribs be cut at the Diſtance of an Inch from it, on each Side.

From all this we ſee, not only that the Thorax is divided into two Cavities entirely ſeparated from each other, by a middle Septum, without any Communication; but alſo that, by the Obliquity of this Partition, the right Cavity is greater than the left: And from hence we may judge of the Uncertainty of trepanning the Sternum, which the Antients have recommended, in ſome Caſes.

The cellular Portion of the Pleura connects the membranous Portion to the Sternum, Ribs, and Muſcles; to the Diaphragm, Pericardium, Thymus, and Veſſels; and, in a Word, to whatever lies near the convex Side of the membranous Portions of the Pleura. It likewiſe inſinuates itſelf between the Laminæ of the Duplicature of which the Mediaſtinum is formed, and unites them together: It even penetrates the Muſcles, and communicates with the cellular Subſtance in their Interſtices, all the way to the Membrana Adipoſa on the external convex Side of the Thorax. In this the Pleura reſembles the Peritonæum.

The Surface of the Pleura, turned to the Cavities of the Breaſt, is continually moiſtened by a lymphatic Seroſity which tranſudes through its Pores, or exhaling Arteries*.

* This Fluid was thought, by ſome Anatomiſts, to be ſecreted by imperceptible Glands; but the Exiſtence of them has not been hitherto demonſtrated. The ſame was likewiſe obſerved in the Peritonæum.

The Arteries and Veins of the Pleura are chiefly Ramifications of the Intercoſtals, which are very numerous, and, for the moſt part, very ſmall. The Mammariæ Internæ and Diaphragmaticæ likewiſe ſend Branches to it, which communicate very frequently with thoſe of the Intercoſtals.

The Mediaſtinum has particular Arteries and Veins, which are commonly Branches of the Subclaviæ. The Mammæ Internæ ſend likewiſe anterior Ramifications, the Diaphragmaticæ to the inferior, and the Intercoſtales and Oeſophagææ to the poſterior Part.

The Nerves are Ramifications of the true Intercoſtales, called alſo Coſtales and Dorſales. Near the Vertebræ they communicate with the great ſympathetic Nerves, improperly called Intercoſtales, and but very little with the middle Sympathetici, or thoſe of the eighth Pair.

The Pleura ſerves, in general, for an internal Integument to the Cavity of the Thorax; the Mediaſtinum cuts off all Communication between the two Cavities, and hinders one Lung from preſſing on the other when we lie on one Side; it likewiſe forms Receptacles for the Heart, Pericardium, Oeſophagus, &c. and is continued over the Lungs as the Peritonæum inveſts the Viſcera.

Before we leave the Pleura, it muſt be obſerved, that theſe Portions of it, which adhere immediately to the Ribs, may be looked upon as the Perioſteum of their internal Sides. This Adheſion keeps the Pleura ſtretched, and hinders it from ſlipping, or giving way: It likewiſe renders this Membrane extremely ſenſible of the leaſt Separation cauſed by a coagulated Lympha, or accumulated Blood; the nervous Filaments being likewiſe, in this Caſe, very much compreſſed, in Inſpiration, by the ſwelling of the intercoſtal Muſcles.

The Thymus is an oblong glandular Body, round on the ſuperior Part, and divided below into two

two or three Lobes; of which, that towards the Left is the longeſt. In the Fœtus it is of a pretty large Size, leſs in Children, and very little in aged Perſons. In Children it is of a white Colour, ſometimes mixed with red; but in an advanced Age its Colour is generally dark.

The greateſt Part of the Thymus lies between the Duplicature of the ſuperior and anterior Portion of the Mediaſtinum and the great Veſſels of the Heart, from whence it reaches a little higher than the Tops of the two Pleuræ, ſo that ſome Part of it is out of the Cavity of the Thorax. In Fœtuſes and Children it lies as much without the Thorax as within it.

Its particular internal Structure and Secretions are not, as yet, ſufficiently known to determine its Uſes; which, however, ſeem to be deſigned more for the Fœtus, than for Adults. It has Veſſels which are called Arteriæ and Venæ Thymicæ.

Conjectures on the Use of the Thymus Gland.

Dionis thought that he had diſcovered the true Uſe of this Gland, by ſaying, that its Uſe in the Fœtus was, to ſecrete the chylous and lacteous Liquors which were poured out into the ſubclavian Vein, and from thence into the thoracic Duct.

This Reaſoning ſeems plauſible enough: But as the excretory Ducts have not yet been diſcovered, therefore we muſt confeſs, that we are, as yet, as ignorant of its true Uſe, as before.

Bellinger is of Opinion, that this Gland prepares a nutritious Fluid in the Fœtus, and conveys it, by particular Ducts, to its Mouth*. But we find, that neither himſelf, nor any Body

* Vid. Tract. de Nutritio.

elſe, have ever been able to demonſtrate theſe pretended Ducts.

Heister ſays, poſſibly the Thymus Gland ſerves to ſecrete the Lymph, which it diſcharges into the thoracic Duct, for the Dilution of the Blood; as the Meſentery and pancreatic Glands do in reſpect to the Chyle.

On this Suppoſition, its Uſe muſt, conſequently, be greater in the Fœtus than after Birth: Becauſe the Want of Reſpiration may well be ſuppoſed to ſubject the Blood to be thicker, and to need Dilution more than afterwards; as nothing tends to attenuate the Blood ſo much as Reſpiration.

It has been found indurated by a Scirrhus, and very large in a Boy about thirteen Years of Age, who died of a hectic Fever.

Dr. Tyson imagined that this Gland ſerved as a Reſervoir of Lympha, to dilute the Chyle of the thoracic Duct of the Fœtus, as its Stomach is continually ſupplied by the Liquor Amnii (as he thought the Fœtus was nouriſhed by the Mouth), which ſwelled the thoracic Duct by this chylous Liquor; becauſe the Blood, which the Fœtus receives from the Uterus, fills up and hinders the Chyle from entering the ſubclavian Vein.

The ſame Author obſerved, that it cannot be doubted but there are Valves in the lymphatic Veſſels of the Thymus, which have Communication with the ſubclavian Vein, as he aſſures us, by injecting this Gland, he has found ſo.

The Heart *

Is a muſcular Body ſituated in the Cavity of the Thorax on the anterior Part of the Diaphragm, be-

* Cor à currendo nomen deſumpſiſſe videtur, unde etiam Belgis (quod alioqui Cervum ſignificat), appellatur Hart, vel Hert, quia ſicut illa Beſtia præ cæteris Animalibus, ita Cor præ cæteris Corporis par-

between the two Laminæ of the Mediastinum. It is, in some measure, of a conical Figure, flatted on the Sides, round at Top, and oval at the Basis. Accordingly, we consider in the Heart the Basis, Apex, two Margins, and two Sides; one of which is generally flat, the other more convex.

Besides the muscular Substance that chiefly forms what we call the Heart, its Basis is accompanied by two Appendices called Auriculæ, and by large Blood Vessels; and all these are included in a membranous Capsula named Pericardium.

It is concave, and divided by a Septum that runs between the Margins into two Cavities called Ventriculi, one of which is thick and solid, the other thin and soft. This latter is generally termed the right Ventricle, the other the left; though, in their natural Situation, the right Ventricle is placed more anteriorly than the left.

Each Ventricle opens at its Basis by two Orifices, one of which answers to the Auricles, the other to the Orifice of a large Artery; and, accordingly, one of them may be termed the auricular Orifice, the other the arterial. The right Ventricle opens into the right Auricle, and into the Trunk of the pulmonary Artery; the left into the left Auricle, and into the Origan of the Aorta. At the Margins of these Orifices are found several

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partibus, Cursu & Motu valet. Quod tamen Belgicum Anglicem nomen etiam derivari posse videtur ab HARDEN, quod durationem, aut ab HARD, quod duritiem significat, vel quia ejus Motus durat, per totum Vitæ Tempus, vel quia substantiæ duritie Musculos aliaque Parenchymata superat.

RIOLANUS nomen deducit à Græco κῆρ, contracto ex κεαρ, quod à κέω, uro, derivatur, quia ex eo Ignis nostri Corporis procedit: Atque sic etiam Belgis Hert, ab Heert; quod focum significari posset.

MENETIUS à καρδαίνω, vibro, concutio, derivat. CHRYSIPPUS ἀπὸ τῆς καρδίας, seu καρδίος, à robori, vel à καρτέω, robustum imperium habeo, quoniam validissimas Actiones edit, & quasi Imperium in reliquas totius Corporis partes habet.

move-

moveable Pelliculæ called Valvulæ; of which ſome are turned interiorly towards the Cavity of the Ventricles, named Triglochines, or Tricuſpides; others are turned towards the great Veſſels, called Semi-lunares, or Sigmoïdales. The Valvulæ Tricuſpides of the left Ventricle are likewiſe termed Mitrales.

The internal Surface of the Ventricles is very uneven, many Eminences and Cavities being obſervable therein. The moſt conſiderable Eminences are thick fleſhy Productions called Columnæ. To the Extremities of theſe Pillars are faſtened ſeveral tendinous Cords, the other Ends of which are joined to the Valvulæ Tricuſpides. There are likewiſe other ſmall ſhort tendinous Ligaments along both Margins of the Septum between the Ventricles: Theſe ſmall Ligaments lie in an obliquely tranſverſe Situation, and form a reticular Texture at different Diſtances.

The Cavities of the internal Surface of the Ventricles are ſmall deep Foſſulæ or Lacunæ placed very near each other, with ſmall prominent Interſtices between them: The greateſt Part of theſe Lacunæ are Orifices of the venal Ducts.

The fleſhy or muſcular Fibres of which the Heart is compoſed, are diſpoſed in a very ſingular Manner, eſpecially thoſe of the right or anterior Ventricle; being either bent into Curvatures, or folded into Angles.

The Fibres which are folded into Angles are longer than thoſe which are only bent into Curvatures; the Middle of theſe Curvatures, and the Angles of the Folds, are turned towards the Apex of the Heart, and the Extremities of the Fibres towards the Baſis: Theſe Fibres differ not only in Length, but in their Directions, which are very oblique in all, but much more ſo in the long or folded

folded Fibres, than in the ſhort ones, which are ſimply bent.

It is commonly ſaid, that this Obliquity repreſents the Figure 8: But the Compariſon is very falſe: and can only agree to ſome bad Figures drawn by Perſons ignorant of the Laws of Perſpective.

All theſe Fibres, Regard being had to their different Obliquity and Length, are diſpoſed in ſuch a Manner, as that the longeſt form partly the moſt external Strata on the convex Side of the Heart, and partly the moſt internal on the concave Side; the Middle of the Curvatures and the Angles meeting obliquely and ſucceſſively to form the Apex.

The Fibres ſituated within theſe long ones, grow gradually ſhorter and narrower all the way to the Baſis of the Heart, where they are very ſhort, and but little incurvated. By this Diſpoſition, the Sides of the Ventricles are very thin near the Apex of the Heart, and very thick towards the Baſis.

Each Ventricle is compoſed of its proper diſtinct Fibres, but the left has many more than the right. Where the two Ventricles are joined, they form a Septum that belongs equally to both.

There is this likewiſe peculiar to the left Ventricle; that the Fibres which form the internal Stratum of its concave Side form the external Stratum of the whole convex Side of the Heart, which, conſequently, is common to both Ventricles; ſo that, by carefully unravelling all the Fibres of the Heart, we find it to be compoſed of two Capſulæ contained in a third.

The anterior or right Ventricle is larger than the poſterior or left, as was well obſerved by the Antients, and clearly demonſtrated by HELVETIUS.

They

They are both nearly of the same Length in Men, and in some Subjects they end exteriorly in a kind of double Apex.

All the Fibres are not directed the same Way, though they are all more or less oblique: For some end towards the right, others towards the left; some anteriorly, others posteriorly, and others in the intermediate Places. So that, in unravelling them, we find, that they cross each other gradually, sometimes according to the Length of the Heart, and sometimes according to its Breadth.

The Tubes that cross each other transversly, are much more numerous than those that cross longitudinally; which ought to be taken Notice of, that we may rectify the false Notions that have been entertained concerning the Motion of the Heart: Namely, that it is performed by a Contorsion, or Twisting, like that of a Screw; or that the Heart is shortened in the Time of Contraction, and lengthened in Dilatation.

The Fibres that compose the internal or concave Surface of the Ventricles, do not all reach to the Basis; some of them running into the Cavity, and there forming the muscular Columnæ, to which the loose floating Portion of the tricuspidal Valves is fastened by tendinous Ligaments.

Besides these musculous Pillars, the internal Fibres form a great many Eminences and Depressions, which not only render the internal Surface of the Ventricles uneven, but give it a great Extent within a small Compass. Some of these Depressions are the Orifices of the venal Ducts found in the Substance of the Ventricles. The Circumferences of the great Openings at the Basis of the Heart are tendinous, and may be looked upon as the common Tendon of all the musculous Fibres of which the Ventricles are composed.

The

The Valves at the Orifices of the Ventricles are of two Kinds: One Kind allows the Blood to enter the Heart, and hinders its Egreſs the ſame Way; the other allows the Blood to go out of the Heart, but hinders it from returning. The Valves of the firſt Kind terminate the Auriculæ, and thoſe of the ſecond lie in the Openings of the great Arteries. The firſt are called Semi-lunar or Sigmoïdal Valves, the others Triglochines, Tricuſpidal, or Mitral.

The Tricuſpidal Valves of the right Ventricle are fixed to its auricular Orifice, and turned internally towards the Cavity of the Ventricle. They are three triangular Productions, very ſmooth on that Side which is turned towards the Auricle, and on that next to the Cavity of the Ventricle they have ſeveral membranous and tendinous Expanſions; and their Margins are indented. The Valves of the auricular Orifice of the left Ventricle are of the ſame Shape and Structure, but they are only two in Number; and, from ſome ſmall Reſemblance to a Mitre, they have been named Mitrales *.

Theſe five Valves are very thin, and faſtened, by ſeveral tendinous Ligaments, to the muſculous Columnæ of the Ventricles. The Ligaments of each Valve are fixed to two Columnæ; and between theſe Valves there are other ſmall ones of the ſame Figure. They may all be termed Valvulæ Tricuſpides, Auriculares, or Venoſæ Cordis.

The ſemi-lunar Valves are ſix in Number, three belonging to each Ventricle, ſituated at the Orifices of the great Arteries; and they may be properly enough named Valvulæ Arteriales: Their concave Sides are turned towards the Cavity of the

* Lieutaud ſays that there are no ſuch Valves, except they be cut thus by the Diſſector. Eſſais Anatomiq. Articl. vi.

Ar-

Arteries, and their convex Sides approach each other. In examining them with a Microscope, we find musculous Fibres lying in the Duplicature of the Membranes which they are composed of.

They are truly semi-lunar, or in Form of a Crescent, on that Side by which they adhere; but their loose Margins are of a different Figure, each of them representing two small Crescents, the two Extremities of which meet at the Middle of this Margin, and there form a kind of small Papilla.

The great Artery that arises from the left Ventricle is named Aorta. As its Egress turns a little towards the Right, and then bends obliquely posteriorly to form what is called Aorta Descendens. From about the Middle of the convex Side of this Curvature three great Branches arise, that furnish an infinite Number of Ramifications to the Head and superior Extremities; as the descending Aorta does, in the same Manner, to the Thorax, Abdomen, and inferior Extremities.

The Trunk of the Artery that arises from the right Ventricle, is called Arteria Pulmonaris: This Trunk, as it is naturally situated in the Thorax, runs, first of all, directly superiorly for a small Space, then divides laterally into two principal Branches, one for each Lung; that which goes to the right Lung being the longest.

The Auricles are muscular Capsulæ situated at the Basis of the Heart, one towards the right Ventricle, the other towards the left, and joined together by an internal Septum and external communicating Fibres, much in the same Manner with the Ventricles; one of them being named the right Auricle, the other the left. They are very uneven internally, but smoother externally, and terminate in a narrow, flat, indented Margin, representing a Cock's Comb, or, in some measure, the Ear of a Dog; and, for that Reason, a famous

Anatomiſt of Leyden would fain have diſtinguiſhed this Margin by the particular Name of Auricle, calling the reſt the Capſula. They open into thoſe Orifices of each Ventricle, which Winslow names auricular Orifices; and they are tendinous at their Opening, in the ſame Manner as the Ventricles.

The right Auricle is larger than the left, and joins the right Ventricle by a common tendinous Opening. It has two other Openings united into one, and formed by two large Veins that meet and terminate there, almoſt in a direct Line, called Vena Cava Superior and Inferior. The ſciſſure Margin of this Auricle terminates obliquely in a kind of obtuſe Apex, which is a ſmall particular Production of the great Capſula, and is turned towards the Middle of the Baſis of the Heart.

The whole internal Surface of the right Auricle is uneven, by reaſon of a great Number of prominent Lines that run acroſs the Sides of it, and communicate with each other by ſmaller Lines, that lie obliquely in the Interſtices between the former. The Lines of the firſt Kind repreſent Trunks, and the others ſmall Branches, in an oppoſite Direction to each other: In the Interſtices between theſe Lines, the Sides of the Auricle are very thin, and almoſt tranſparent, ſeeming to be formed merely by the external and internal Tunics of the Auricle joined together, eſpecially near the Apex.

The left Auricle is, in the human Body, a kind of muſcular Capſula, or Reſervoir, of a pretty conſiderable Thickneſs, and unequally ſquare, into which the four Veins open called Venæ Pulmonares, and which has a diſtinct Appendix belonging to it, like a third ſmall Auricle. This Capſula is very even on both Sides, for which Reaſon one might be led to call it the Trunk of the pulmonary Veins, and its Appendix the left Auricle.

Auricle. However, the Capsula and Appendix have but one common Cavity; and therefore may still be both comprehended under the common Name of the left Auricle. In Men, the small Portion may likewise be named the Appendix of the left Auricle, but in other Animals the Case is different.

This small Portion or Appendix of the left Auricle is of a different Structure from that of the Capsula or large Portion. Externally it resembles a small oblong Bag, bent different Ways, and indented quite round the Margins; internally it is like the Inside of the right Auricle. The whole common Cavity of the left Auricle is smaller in an adult Subject than that of the right; and the musculous Fibres of this left Auricle cross each other obliquely, in Strata differently disposed.

Besides the great common Vessels, the Heart has Vessels, peculiar to itself, called the coronary Arteries and Veins; because they, in some measure, crown the Basis of the Heart. The coronary Arteries, which are two in Number, rise from the Beginning of the Aorta, and afterwards spread themselves round the Basis of the Heart, to the Substance of which they send numerous Ramifications.

The external Course of the Veins is pretty much the same with that of the Arteries; but they end partly in the right Auricle, and partly in the right Ventricle: They likewise terminate in the left Ventricle, but in smaller Numbers; and in both they end by certain venal Ducts, which open into the Fossulæ or Lacunæ already taken Notice of, in the uneven internal Sides of the Ventricles. There are likewise Lacunæ of the same Kind in the Auricles between the prominent Lines before-mentioned; and in the great Capsula of the left

Au-

Auricle we find likewiſe ſmall Foraminæ which ſeem to have the ſame Uſe.

There are ſeldom more than two Arteries; one of which lies towards the Right, the other towards the Left of the anterior third Part of the Circumference of the Aorta. The right coronary Artery runs in between the Baſis and right Auricle, all the way to the flat Side of the Heart, and ſo goes half way round; the left Artery has a like Courſe between the Baſis and left Auricle; and, before it turns on the Baſis, it ſends off a capital Branch, which runs between the two Ventricles: Another principal Branch goes off from the Union of the two Arteries on the flat Side of the Heart, which, running to the Apex, there joins the other Branch.

The coronary Veins are diſtributed exteriorly, much in the ſame Manner. Their Trunk opens principally into the right Auricle by a particular Orifice furniſhed with a ſemi-lunar Valve. All the coronary Veins and their Ramifications communicate with each other ſo, that if we blow thro' a ſmall Hole made in any of theſe Branches, having firſt compreſſed the Auricles and large Veſſels, we ſee, that the Air ſwells all the Veſſels, and the Ventricles likewiſe by paſſing through the Ductus Venoſi.

The Heart lies almoſt tranſverſly on the Diaphragm, the greateſt Part of it being in the left Cavity of the Thorax, and the Apex being turned towards the oſſeous Extremity of the ſixth true Rib. The Baſis is towards the right Cavity; and both Auricles, eſpecially the right, reſt on the Diaphragm.

The Origin or Baſis of the pulmonary Artery is, in this natural Situation, the higheſt Part of the Heart on the anterior Side; and the Trunk of this Artery lies in a perpendicular Plane, which may be conceived to paſs between the Sternum and the

Spina Dorsi: Therefore some Part of the Basis of the Heart is in the right Cavity of the Thorax; and the rest, all the way to the Apex, is in the left Cavity: And it is for this Reason that the Mediastinum is turned towards that Side.

According to this true natural Situation of the Heart, the Parts commonly said to be on the right Side are rather anterior, and those on the left Side posterior; and that Side of the Heart, which is thought to be the anterior Side, is naturally the superior Side; and the posterior Side, consequently, the inferior Side.

The inferior Side is very flat, lying wholly on the Diaphragm; but the superior Side is a little convex through its whole Length, in the Direction of the Septum, between the Ventricles. And it may be proper here to remark, that though commonly received Terms of Art may still be retained, yet it is necessary to prevent their communicating false Ideas to those who have not had an Opportunity of making Observations themselves, or of being instructed by others.

There are still some other anterior Veins of the Heart: But one, more particularly large, goes along the adjacent Margin of the right Ventricle, and, running for some Length obliquely between the Membranes, is inserted into the most anterior Part of the right Auricle, and sometimes into the Trunk of the superior Vena Cava. This anterior Vein sends off another concealed, or through the Root of the right Sinus; and, being again terminated in the great coronary Vein, makes a complete Circle round the Heart like arterial ones, which some have described, but I have not yet seen it. HALLER.

As for lesser venal Circles about the Heart, as well as the said arterial one, they are not yet sufficiently confirmed.

There

There are alſo a great many more Veins, of which it is uncertain whether they belong to the Baſis and internal Parts of the Heart, to which Anatomiſts have ſeldom any Acceſs, becauſe they lie concealed between the Origins of the large Veſſels; and theſe open and terminate, by a Multitude of Orifices, in the right Sinus and Auricle; and ſome, but only a few, in the left one.

Thus HALLER has ſeen a particular Vein, which, from a latent Sinus in the muſcular Subſtance of the right Auricle, has aſcended towards the Aorta and pulmonary Artery, and terminated, on one Side, in the greater coronary Vein. He ſaw another concealed between the Orifice of the ſame Vein and the Aorta, terminated in the right Sinus; and alſo another through the Remains of the Foramen Ovale and Septum; the two Sinuſes terminating in the right Sinus; and others, again, belonging to the venal Valves: Beſides which, there are ſtill others, too numerous to deſcribe.

Some other much ſmaller Veins in the Heart, whoſe little Trunks, being very ſhort, cannot eaſily be traced by Diſſections; and theſe terminate, by an infinite Number of oblique ſmall Orifices, through all the numerous Foveæ, or little Sinuoſities and Excavations, obſervable throughout the Surface of both the Ventricles.

Theſe are demonſtrated by injecting the coronary Arteries, after you have firſt tied their correſponding Veins. HALLER. Prim. Lin. Phyſiol.

There are ſome Authors who will have the coronary Arteries filled with Blood, not at the Time of the Syſtole of the Heart, but of that of the Aorta; which they think muſt be a Conſequence of the retrograde Angle of the Blood's Courſe here, and the Paleneſs of the contracted Heart,

on a Suppoſition that the Valves of the Aorta cover or cloſe the Orifices of the coronary Arteries.

But the two laſt Suppoſitions do not correſpond with Experiments. For the retrograde Courſe can only impede, or leſſen, and not intercept the Flux into the Heart. For injecting Air or Mercury into all the ſeminal and biliary Veſſels, demonſtrate, that the large retrograde Angles, which the Veſſels often there make, do not hinder the Fluids from taking their natural Courſe, though they retard it.

But what is more evident is, that the coronary Artery, and Blood ſtarting from it, make a higher Saltus at the Time when the Heart is contracting.

Concerning the Reflux of Blood from the muſculous Subſtance of the Heart, there is ſtill leſs room to doubt: For all the coronary Veſſels diſcharge their Contents into the Auricles and Ventricles, either right or left, but leſs in the latter. The Circulation through theſe Veſſels ſeems to be completed in the ſhorteſt Space of Time that can be in any Part, from the great Velocity the Blood receives from the Heart itſelf, urging the ſame through its own Subſtance. But that the whole Contents of the Veſſels are cleared in each Contraction, HALLER does not think it probable: For the ſanguineous Veſſels of the Heart do not look pale enough, in that Action, to produce ſuch an Effect as an entire Evacuation.

There is a very free Communication between the Arteries of the Heart into its cellular Membrane. If it be aſked, What are the Uſes of thoſe leaſt or ſhorteſt Veins which open obliquely through the Surfaces of both the Ventricles? We anſwer, They ſerve to receive the Blood of thoſe deeply-ſeated ſmall Arteries, within the muſcular Subſtance, which have no correſponding Veins running by their Sides like thoſe on the Surface.

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The lymphatic Veins of the Heart, which accompany the coronary ſanguineous Veſſels, and aſcend towards the thoracic Duct and ſubclavian Vein, are very rarely to be ſeen. HALLER. Prim. Lin. Phyſiolog.

OBSERVATION.

It appears, from what has been ſaid, that the Force of the Heart is manifeſtly great in thoſe who have ſtrong Fibres, not too eaſily irritable, with a Pulſe large, and moderately ſlow. For the Number of Pulſes being given, the Strength of the Body, Health, and Diſeaſe, will be as its Magnitude, if the Arteries are duly pervious; and if the Magnitude be given, the Patient's Strength will be as the Slowneſs of the Pulſations, if there be no obſtructing Cauſe at the Heart: So the Strength will be in a Ratio compounded of the Magnitude and Slowneſs of the Pulſe. Thus the Perſon's Strength, and the arterial Reſiſtance, with the Tenacity of the Humours, being the ſame; the Quantity of the Heart's Contraction will be as its Irritation, from the Plenitude and Tenſion of its Ventricles. The arterial Reſiſtance and Heart's Plenitude being the ſame, its Contraction will be as the nervous or muſcular Strength of the Body: Or the Heart's Strength and Plenitude being given, its Syſtole will be as the Reſiſtance inverſly.

If the Heart, weakened, throws out leſs than it receives; the Pulſe quickens, to compenſate the want of Magnitude: And ſo the Heart may labour with Oppreſſion, either from the venal Preſſure increaſed; from the arterial Reſiſtance augmented; or from a nervous Weakneſs of the muſcular Strength, or vital Powers: And theſe make the immediate Caſes of Fevers, which reſult, again, from Changes, made by the Nonnaturals, either in the automatic and muſcular Powers of the Heart and Arteries, in the Encephalon and nervous Syſtem;

ſtem; or in the Quantity and Quality of the Blood and principal Humours thence ſecreted. Dr. MIHLES's Remark on HALLER's Phyſiology.

The Heart, with all the Parts belonging to it, is contained in a membranous Capſula called Pericardium, which is, in ſome meaſure, of a conical Figure, and much bigger than the Heart. It is not fixed to the Baſis of the Heart, but round the large Veins above the Auricles, before they ſend off the Ramifications, and round the large Arteries, before their Diviſions.

The PERICARDIUM is compoſed of three Laminæ, the middle and chief of which is compoſed of very fine tendinous Filaments, cloſely interwoven and croſſing each other in different Directions. The internal Lamina ſeems to be a Continuation of the external Tunic of the Heart, Auricles, and great Veſſels; the Trunks of the Aorta and pulmonary Artery have one common Tegument which contains them both as in a Sheath, and is lined on the internal Side by a cellular Subſtance, chiefly in that Space which lies between where the Trunks are turned to each other, and the Sides of the Sheath. There is but a very ſmall Portion of the inferior Vena Cava contained in the Pericardium.

It is the middle Lamina which chiefly forms the Pericardium; and the Figure of this Capſula is not ſimply conical, its Apex being very round, and the Baſis having a particular Elongation which ſurrounds the great Veſſels, as amply as the other Portion ſurrounds the Heart.

The Pericardium is cloſely connected to the Diaphragm, not at the Apex, but exactly at that Place which anſwers to the flat or inferior Side of the Heart; and it is a very difficult Matter to ſeparate it from the Diaphragm in Diſſection. This adhering Portion is, in ſome meaſure, of a triangular Shape, correſponding to that of the inferior

Side

Side of the Heart; and the reſt of the Capſula lies upon the Diaphragm, without any Adheſion.

The external Lamina or common Covering, as it may more properly be called, is formed by the Duplicature of the Mediaſtinum. It adheres to the proper Capſula of the Pericardium by the Intervention of the cellular Subſtance in that Duplicature, but leaves it where the Pericardium adheres to the Diaphragm, on the ſuperior Surface of which it is ſpread, as being a Continuation of the Pleura.

The internal Lamina is perforated by an infinite Number of very ſmall Foramina, through which a ſerous Fluid continually tranſudes, in the ſame Manner as in the Peritonæum: This Fluid, being gradually collected after Death, makes what is called Aqua Pericardii, which is found, in conſiderable Quantities, in opening dead Bodies while they remain freſh. Sometimes it is of a reddiſh Colour, which may be owing to a Tranſudation of Blood through the fine Membrane of the Auricles.

The Heart, and Parts belonging to it, are the principal Inſtruments of the Circulation of the Blood. The two Ventricles ought to be conſidered as two Syringes ſo cloſely joined together as to make but one Body, and furniſhed with Suckers placed in contrary Directions to each other, ſo as that, by drawing one of them, a Fluid is let in, and forced out again by the other.

The Heart is compoſed of a Subſtance capable of Contraction and Dilatation. When the muſculous Fibres of the Ventricles are contracted, the two Cavities are leſſened in an equal and direct Manner, not by any Contorſion or Twiſting, as the falſe Reſemblance of the Fibres to a Figure of 8, has made Anatomiſts imagine: For if we conſider attentively in how many different Directions,

and in how many Places, these Fibres cross each other, as has been already observed, we must see clearly, that the whole Structure tends to make an even, direct, and uniform Contraction, more according to the Breadth or Thickness, than according to the Length of the Heart; because the Number of Fibres situated transversly, or almost transversly, is much greater than the Number of longitudinal Fibres.

The musculous Fibres, thus contracted, do the Office of Suckers, by pressing upon the Blood contained in the Ventricles; which Blood, being thus forced towards the Basis of the Heart, presses the tricuspidal Valves against each other, opens the Semi-lunares, and rushes, with Impetuosity, thro' the Arteries and their Ramifications, as thro' so many elastic Tubes.

The Blood, thus pushed on by the Contraction of the Ventricles, and afterwards pressed by the elastic Arteries, enters the capillary Vessels, and is from thence forced to return by the Veins to the Auricles, which receive and lodge the Blood returned by the Veins during the Time of a new Contraction. This Contraction of the Heart is, by Anatomists, termed Systole.

The Contraction or Systole of the Ventricles ceases immediately, by the Relaxation of their musculous Fibres, and in that Time the Auricles which contain the venal Blood, being contracted, force the Blood through the tricuspidal Valves into the Ventricles, the Sides of which are thereby dilated, and their Cavities enlarged. This Dilatation is termed Diastole.

In this Manner does the Heart, by the alternate Systole and Diastole of its Ventricles and Auricles, expel the Blood through the Arteries to all the Parts of the Body, and receive it again by the Veins;

Veins: This is called the Circulation of the Blood, which is carried on in three different Manners.

The first and most universal Kind of Circulation is that by which almost all the Arteries of the Body are filled by the Systole of the Heart, and the greatest Part of the Veins evacuated by the Diastole.

The second Kind of Circulation opposite to the first, is through the coronary Vessels of the Heart, the Arteries of which are filled with Blood during the Diastole of the Ventricles, and the Veins emptied during the Systole.

The third Kind of Circulation is that of the left Ventricle of the Heart, through the venal Ducts of which a small Quantity of Blood passes without going through the Lungs, which is the Course of all the remaining Mass of Blood.

Besides these three different Kinds of Circulation, there are some Peculiarities in the Course of the Blood which may be looked on as particular Circulations: Such is the Passage of the Blood through the Liver, Spleen, Corpora Cavernosa of the Parts of Generation, and through the cavernous Sinuses of the Dura Mater. I do not here examine the Circulation peculiar to the Fœtus, nor in the minute Vessels.

Conjectural Observation.

If it be demanded, Why the Heart never ceases from its perpetual Motion, for so many Years as there are in a Man's Life, through so many Hours as are in a Day; when, in each Hour, the Heart of a healthy Person contracts not much less than five Thousand Times; so often are there successive Repletions, followed with new Contractions, perpetually in the same constant Order. Nor is there any other Muscle, besides the Heart and Diaphragm, but what becomes tired and painful, by acting incessantly, even for a few Hours.

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Various Anſwers have been given to this Queſtion, by ingenious Men, founded either upon a Compreſſure of the cardiac Nerves between the large Arteries, or upon an alternate Repletion of the coronary Arteries, Cavities of the Heart, &c.

HALLER thinks, that the Simplicity of Nature ſeems very great in this Matter. When the Auricle is relaxed, it is immediately filled by the muſcular Force of the continuous great Vein; and ſo the Heart alſo contracts itſelf, when, in like manner, it is irritated by the Blood driven into it from the Auricle: Therefore the Heart, having once received the Blood, is contracted by that Stimulus, or irritable Force, whereby muſcular Fibres are excited to a Contraction; whereupon, it empties itſelf of the Blood; and, being free from the Stimulus thereof, immediately reſts, and relaxes itſelf. But the Heart being now relaxed, the Auricle is, in like manner, irritated by its contained Blood, and, by contracting, fills it again; while the inceſſant Actions of the Heart and Arteries continually urge new Fluids into the right Sinus of the Auricle. The Motion aſcribed to the Vena Cava is, from the right Auricle throwing back ſome Blood again into the ſuperior and inferior Cava; becauſe now the fainting Heart will not receive it all.)

That this is the true State of the Heart's Motions, is proved by actual Experiments and Obſervations; whereby we plainly diſcern the ſucceſſive Repletions and Contractions made in the great Vein, Auricle, Ventricle, and Artery, eaſily ſeen in a weak or expiring Animal; but more eſpecially, and more evidently, in thoſe Animals that have but one Ventricle in the Heart; as the Tortoiſe, Frog, Snake, Fiſhes, and in the Chick hatching in the Egg: Which, inſtead of a Heart, has only one crooked Canal.

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The ſame is alſo confirmed from the Reſting of the Heart, which follows upon tying the Veins, and from the Return of its Motion by removing the Ligatures, or by the Impulſe of the Wind or Liquors injected; and, laſtly, from the perpetual Contraction of a Frog's Heart, round or upon a Veſicle of Air inflating it; which Air, urged into it by the Veſicle, will alternately receive, and, for many Hours, tranſmit to the common Air.

Hence it appears why the Auricles, and eſpecially the right, are the laſt of all moving, if you except the next continuous Part of the Vena Cava: Becauſe the Heart is irritated into Motion by the Blood ſent towards it, by a Contraction of the extreme Parts from the Cold invading the Body; at which Time the Lungs, deſtitute of the Act of Reſpiration, reſiſt the Blood of the right Ventricle; but the left, receiving none, ſtands ſtill for want of Irritation.

Nor does HALLER believe that there is any Thing more than this required for the Heart's Motion. For if we derive the Heart's reſting, from a Compreſſure of the Nerves, the Motion of the Auricles will be an Objection: whoſe Nerves, in order to that, ought not to be compreſſed: And, for Example, in Fiſh, and the little Chicken in the Egg, there can be no Room for a Compreſſure of the Nerves.

If, again, you deduce the Heart's Reſt from a Compreſſure or Occluſion of the coronary Arteries, this is contrary to Experience; ſince they are not covered by the Valves of the Aorta; and from a Wound of the ſaid Arteries, during the Syſtole of the Heart, the Blood ſtarts out to a great Height: And, again, its Motion ſtill continued, after they were tied by the late Dr. CHIRAC.

But there is ſuch an abſolute Impatience in the Fibres of the Heart to bear any Stimulus, that, even

even when the Viſcera are almoſt dead, this appears to have a kind of Motion within its own Fibres; which, beginning in a ſort of radiant Point, is propagated, in Wrinkles, to the adjacent Parts: If, now, you pull out the Heart, although it be growing cold, and then puncture, inflate, or irritate its Membranes, the Fibres of the extracted Heart become corrugated in Circles, notwithſtanding there is not now a continuous Nerve or Artery to ſupply the beating Heart. (And this Irritability of the Heart is more exquiſite and durable than in any other Part of the Body; becauſe we ſee that it may be thereby recalled into its former Motion by a Stimulus, when no other Muſcle can be ſo excited.)

But with what Celerity, and with what Force, the Heart drives the Blood, is controverted, and variouſly computed. The more modern Authors have founded their Calculations on a Suppoſition that, for the Celerity to be determined, we are to admit two Ounces of Blood to iſſue out of the Heart with Celerity; that the Part of the whole Pulſe, called its Syſtole, makes one Third of the whole Pulſation, and is finiſhed within a $\frac{1}{2\frac{1}{2}\frac{1}{5}}$th Part of a Minute; but the Area of the Orifice of the Aorta they have eſtimated 0.4187 Parts of an Inch; ſo, by dividing the Space filled by two Ounces of Blood, (3.318 Inch) by the Area of the Section of the Aorta at its Orifice, (and the Length of its Cylinder filled by two Ounces, viz. $= 7\frac{29309}{331180}$) the Number thence produced divided by $2\frac{1}{2\frac{1}{5}}$, the Time in which the Heart contracts, they find 149 Feet, and two Tenths of an Inch, for the Space through which the Blood runs in a Minute, if it goes on, in a Cylinder, with the ſame Velocity it firſt had from the Heart, which it does not. But the incumbent Weight of the Blood moved by the Heart, they have computed by the

Jet,

Jet, wherein the Blood ſtarts forth from the larger Arteries in a living Animal, being ſeven Feet five Tenths, and from the Surface of the Ventricle, the whole Area makes fifteen Inches; which produce 1350 cubical Inches of Blood, or 51 Pounds 5 Ounces, which preſs againſt the Ventricle of the contracting Heart. The Heart, therefore, thus drives forward a Weight of 51 Pounds with a Velocity by which it may run through 149 Feet in a Minute; which Force it exerts 4800 Times in an Hour.

Although there are many Particulars here, unthought of, which may render the Eſtimate incomplete, and ſuch, perhaps, as we may never get over; and although the Area of the Ventricle be of ſo uncertain Dimenſions, and the Jet of Blood computed from an inſufficient Height; yet, if we conſider the Violence with which the Blood ſtarts from ſome of the leaſt ſanguine Arteries in the living Animal, although we cannot eaſily determine how much of the Heart's Syſtole it aſſumes to itſelf, and a Variation, in this, will greatly alter the Computation: Yet, in the mean Time, it will plainly appear, that the Muſcles we call the Heart, make a very powerful Machine.

The Truth of this is evident from various Experiments; in which it appears to be very difficult to fill all the ſanguineous Veſſels by anatomical Injections, and quite impoſſible to fill all the ſmaller of them: Yet the Heart, by the Help of the Elaſticity of the Arteries, we ſee, not only gradually diſtends all the larger, the ſmaller, and even the leaſt Arteries: I have ſeen, the Blood ſtarts forth ſeveral Feet, the Jet deſcribing a Parabola, whoſe Height was four Feet, and Amplitude of the Projection ſeven: And aſſert, that they have ſeen the Blood aſcend from the Aorta to the Height of 12 Feet.

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There is no doubt but the Heart moves not only the whole Mass of the animal Fluids, but also all the yielding Solids, and even every individual yielding Fibre is elongated by each Systole: But then this is owing to the Mechanism also of the arterial Fabric, which makes a Leaver of very great Purchase, for multiplying and transferring the Force of the Heart, which the Arteries receive and apply, so as to produce great and extensive Effects.

But then we must not ascribe to the Heart, alone, Effects which it can produce only by the Assistance of the Arteries; and, if all Circumstances be duly considered, the Heart's Force will be found so far short of BORELLI's enormous Calculation, that it will be less than any Computation yet observed of it.

As to the Time in which the Mass of Blood may make a complete Circulation thro' the Heart, as it flows with an irregularly decreasing and increasing Motion, that varies in every Artery, and in Veins, proportionably to their several Lengths, Diameters, Angles, Inflexions, Strength, &c. no one can justly determine it.

The Return of the Fluids may be twenty Times quicker through the coronary Vessels of the Heart, with those of the intercostal and diaphragm Muscles, than in many other Parts: And it may move an hundred Times slower through the least Vessels of the Liver, than in the largest Veins at the Heart.

However, on Dr. HALE's Principle, the larger Arteries may shift their Contents into the Veins, and the smaller ones may pass their Blood through the Heart, once in about five or six Minutes; in which Time the Majority of the Current passes the Heart in one complete Round. MIHLES's Observations.

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Moreover, that we may make a juſt Eſtimate of the Heart's Force in living Animals, we muſt conſider what great Reſiſtances that complex Muſcle overcomes; we muſt compute the enormous Weight there is of the whole Maſs of Fluids, perhaps about fifty Pounds: For all that Quantity, one ſtagnant in a Perſon lately drowned, or fainted away, are eaſily put into their former Motion by the Heart only.

We muſt again obſerve the great Decreaſe of the Blood's Velocity, ariſing from the greater Capacity of the dividing Branches (from whence the Ratio of its Celerity, even in the Inteſtines, may be computed to only a 24th or a 30th Part of its original Impulſe), abates two Thirds from the Heart's Force: And yet we ſee there are Humours ſwiftly moved through much ſmaller Veſſels. For Example, in thoſe of the Sanctorian Perſpiration; which, in a ſubterraneous Cavern, HALLER has obſerved to aſcend ſwiftly in Form of Vapour or Smoke: And the ſame Celerity of the Blood, in the capillary Veſſels of ſmall Fiſhes, &c. is viſible to the Eye by Help of a Microſcope.

Now ſince the Frictions, in every Machine, always conſume a great Part of the moving Forces; much more do they in the human Body, whoſe Blood and Juices are ſo much more viſcid or clammy than Water, and paſs through Veſſels ſo minute, that they permit only a Globule to paſs at a Time, and even hardly allow that, without changing its Figure. But from ſo ſtrange and extended a Friction muſt neceſſarily follow, a very great Hindrance to the Motion: Whence we may eaſily underſtand, that the Force muſt be very great, which drives ſo ſwiftly ſuch a prodigious Maſs of Fluids over ſo many Reſiſtances and Decrements of the moving Forces. HALLER.

It is proper we ſhould obſerve here, that the Heart fills the ſmaller Veſſels, not at once, but by repeated Syſtoles, with the Aid of the Elaſticity of the Arteries which communicate in a ſerpentine Manner: We are alſo to conſider, that a very ſmall Part only of theſe Reſiſtances is removed, each Time, by any ſingle Syſtole, to which the Arteries ſerve as a multiplying Spring by their elaſtic Force, proportionable to their Diſtenſion, and drive progreſſively the Maſs of Fluids, in the ſame Manner as the Air, by its Elaſticity, throws out a continued Stream with a Celerity proportionable to its Compreſſure, in the Fire Engine, &c. For as the arterial Valves of the Heart, which ſuſtain a Part of this elaſtic Force equal to their Surface, will admit of various Apertures; the Heart acts on that hydraulic Law, whereby any Force or Preſſure, ever ſo weak, by urging a Fluid through an Aperture, proportionably ſmall, ſhall overcome any Reſiſtance, or raiſe any Weight, ever ſo great. So that, whenever the arterial Reſiſtance is increaſed, or the muſcular Force of the Heart abated, its Valves are opened by a proportionably ſmaller Column of Blood; which, in a natural eaſy Syſtole, is ſeldom more than Half the Contents of either Ventricle; as, in a natural Expiration, the Lungs ſeldom expel more than Half their contained Air.

Hence it appears, that to allow an Opening to the Valves, equal to the Orifice of an Artery, and the Quantity of Blood expelled, to be equal to the Capacity of the Ventricle, are Conceſſions too great, by Half, to eſtimate the natural Force of the Heart; which, when reduced to but a few Ounces, is yet, according to the hydraulic Principle, able enough to maintain the Circulation.

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An Essay on the Cause of the Motion of the Heart. By Haller.

Although this Essay is but short, yet it will have its Uses; seeing you will find an Experiment in it, which I have made several Times, and which proves that the Motion of the Heart, by perpetual alternate Contractions and Relaxations, depends upon Irritations occasioned by the venal Blood which is sent thither.

All the Explanations which have hitherto been given of this Phænomenon, are destroyed by the human or comparative Anatomy.

We know perfectly well, that the right Ventricle, and especially its Auricle, are the last Parts of the Body which preserve any Motion. Galen, Harvey, and Boerhaave, were convinced of this by Experiments.

I have long suspected, that the Continuance of this Motion depended upon the Blood which the Venæ Cavæ, contracted by the Cold, and compressed by the Palpitations and Weight of the Muscles, send continually to this Ventricle; whereas the Lungs of a dying Animal, being motionless and collapsed, no longer admit the Blood by the pulmonary Artery; and that all the Quantity, which its Contraction can force into the left Auricle, is too inconsiderable, compared with that which returns from the whole Body to the right Auricle, to produce a sensible Effect. It may therefore be affirmed, that if the right Ventricle and Auricle move longer than the left Auricle, it is because the venal Blood is sent longer thither.

I determined to confirm my Conjecture by Experiments; and, in order to this, it was necessary, if possible, to prevent the Entry of the Blood into the right Ventricle; and if, by this means, its Mo-

tions were ſtopped, that was a Proof that they actually depended upon the Acceſs of the Blood.

I attempted this Experiment, at firſt, by Ligatures; becauſe I remember to have read in BARTHOLIN and BERGER, that the tying up of the Veins makes the Motion of the Heart ceaſe; and that it begins again when the Ligature is cut. And HARVEY ſays, that he has made the ſame Experiment upon a Serpent.

But the Experiment, done in this Manner, did not ſucceed; becauſe, as long as the Animal is ſtill warm, the Blood contained in the right Auricle continues to move it, though there is none ſent to it by the Venæ Cavæ: And after having tried them on three young Cats, the Motion of the Blood continued as before. The ſame Thing happened to BLANQUET, in the Experiments related by Dr. SENAC.

This made me reſolve to ſlit both the Cauſes: I ſhould have cut them quite off, if I had not been afraid, that then the Ceſſation of the Motions of the Heart would have been attributed to the want of its neceſſary Supporters. After having ſlit them, I emptied them of all their Blood, and tied them; I next emptied the Auricle, and then the Succeſs of the Experiment was always conſtant. As ſoon as I had freed the Auricle of all its Blood, and prevented it from receiving any afreſh, immediately its Motion entirely ceaſed. As it is more difficult to empty the Ventricle than the Auricle, and as it yields to the Impreſſions which are communicated to it by the left Ventricle; I ſometimes obſerved there a gentle Motion, but incomparably weaker than that which it has when it receives the Blood from its Auricle and the Venæ Cavæ.

But there ſtill remained a more authentic Experiment for me to make. In the natural State

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the right Ventricle moves longer than the left; becauſe, as I ſaid before, it receives the venal Blood longer than the other. To prove, to a Demonſtration, that the Blood is actually the Cauſe of the Heart's Motion, there is nothing farther required to be ſhewn than that if the right Ventricle and its Auricle are deprived of the Blood, while the left Ventricle is not, the firſt immediately loſes its Motion, while the other ſtill continues to act.

In order to ſucceed in this Experiment, the Ventricle muſt firſt be perfectly emptied, by opening the pulmonary Artery and Venæ Cavæ, and the emptying the left Ventricle prevented, by tying the Aorta; and, after this is done, we muſt examine narrowly, if the Motions of the right Ventricle ceaſe, and if the left and its Auricle continue theirs.

After ſome Attempts, which the Difficulty of ſo delicate an Undertaking, and the ſudden Death of the Animals, rendered fruitleſs; the Experiment, at laſt, ſucceeded to my Wiſh; viz. the right Auricle remained perfectly quiet, and its Ventricle preſerved no other Motion than that which was a neceſſary Conſequence of the Connexion of its Fibres with thoſe of the left Ventricle, and which pulled the external Parietes towards that which ſeparates the two Ventricles from each other. The left Auricle preſerved its Motion for ſome Time, the left Ventricle ſtill longer; and I have ſometimes obſerved this laſt contract two Hours after the other had ceaſed.

When the Experiment ſucceeded exactly, the Blood mounted from the Apex to the Baſis of the left Ventricle, and deſcended again from the Baſis to the Point, and then the left Ventricle, as long as it preſerved any Motion, appeared likewiſe to deſcend. At other Times, as I have ſeen in a

Kid, it had no Motion at all. This Experiment ſucceeded beſt when the left Auricle emptied itſelf freely into the Ventricle, and the Paſſage of the Blood from the Ventricle into the Aorta, which was tied, was entirely ſtopped. The Apex of the left Ventricle was always the Part which preſerved its Motion the longeſt. By this means, the Property of being the laſt living Part of the Body is transferred from the right Ventricle to the left, by preſerving longer, in the laſt, the Irritation produced by the Contact of the Blood.

A new Force may be given to this Experiment, by trying to blow into the right Ventricle; by which Irritation its Pulſations are renewed.

Farther: I have always remarked, that the internal Surface of the Heart is much more irritable than the external: For, when I irritated this laſt with the ſtrongeſt Poiſons, the Motion thereby communicated to the Heart ſoon ceaſed; whereas the Irritation communicated to the internal Surface, by means of Air alone, eſpecially in Frogs, and even in Cats, Motions which ſubſiſted a very long Time, even after all the Parts were quite cold.

I have repeated this laſt Experiment nine Times; viz. of preſerving the Motion of the left Ventricle after all the other Parts were deprived of theirs; ſeven Times upon Cats, and twice on Kids. The violent Struggling and Agitation of Dogs, render them improper Subjects for this Purpoſe.

Morbid Cases of the Heart, &c.

Vieussens found, in the Body of a Soldier, aged Thirty-five Years, who died of a Defluxion of the Breaſt, two Hearts; one of which, that he thought was perfect in its Conformation, and in its natural Situation, but had no Pericardium:

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The other Heart, whose Figure was pyramidal, and as large as a Hen's Egg, had a Pericardium, which adhered on its external Surface. A large Branch of each subclavian Vein was inserted into its Basis and Cavity, which terminated on its right Side at the superior Trunk of the Vena Cava. This Heart had no Auricles, but only a Cavity, which we have just mentioned, which may be looked upon as a Ventricle: This was situated above the other, and reached the Basis by its Apex. Vid. VIEUSSENS. Tract. Cord.

Often in the Ventricles of the Heart, and Prominence of the pulmonary Artery and Aorta, is found Concretions of Fluids, especially in Persons of advanced Age; but sometimes I have found, even in Children, those Concretions named Polypuses. RIOLANUS says he has found them as big as the Wrist.

CHESELDEN found, in the Pericardium of a Boy, a great Quantity of Pus, and the Basis of the Heart ulcerated. He observes, that, in Persons who died of a Dropsy, the Heart is generally large, its Fibres lax, and the Vessels about it immoderately distended; with Polypuses, sometimes, in both Auricles, Ventricles, and Veins.

Mr. PILE has prepared a Heart, thus diseased, whose Circumference, from the Apex round the Basis of the Auricles, measures Twenty-four Inches and a Quarter; and round the Basis of the Ventricles, Seventeen Inches and a Half.

CHESELDEN dissected a Man, who died tabid, in whom the Pericardium universally adhered to the Heart; and a Portion of it, as large as a Six-pence, was ossified.

The Beginning of the Aorta is frequently indurated, especially in aged Persons.

CHESELDEN found, in a Woman who died of a Dropsy, the Valves of the Aorta quite covered

with petreous Matter; which not ſuffering them to perform their Functions, the left Ventricle of the Heart was conſtantly overcharged with Blood, and diſtended to above twice its uſual Bulk.

In a Man who died with exceſſive Palpitations of the Heart, and an irregular Pulſe, which began after hard Drinking in extreme hot Weather ſome Years before, the ſame Perſon found about Ten Inches of the Aorta, neareſt to the Heart, diſtended three Times more than its uſual Diameter: And in another Man, of One Hundred and Three Years old, he alſo found the ſame Part of the Aorta expanded to twice its natural Capacity, without any Symptom of the Diſeaſe in his Life-time. See his Anatomy.

BLANCHARD relates, that he found a Heart of a whitiſh Colour about the Middle. Towards the Diaphragm it was ulcerated, putrid, and partly conſumed, without any Fluids in the Pericardium: The Lungs were alſo of a whitiſh Colour, and adhered to the Ribs and Diaphragm. Vid. Obſervatio XL.

He alſo found, in a Girl of Ten Years old, who was troubled with a Pulſation in the Heart, which was ulcerated, and very near half conſumed. Ibid. Obſerv. LXXXIII.

OBSERVATIONS.

BONETUS ſpeaks of a Man, who died of a Dropſy, in whoſe Pericardium there was found Thirty Ounces of Water. Obſ. LX.

PISO ſays of JACOB LORET, who had long laboured under a Palpitation of the Heart, and Difficulty of Breathing, that, upon Diſſection, ſeveral Pints of Water were found in the Pericardium. Vid. De Seroſ. Colluv. Obſ. XXXIX.

Dr. STORKIUS informs us, that he ordered the Sternum to be perforated after a Wound received

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in the Thorax, whereby Six Pounds of Blood, diluted with Water, was evacuated. Alſo the left Side of the ſame Man was opened, from which more than Nine Pounds of a ſanguineous gelatinous Matter iſſued. The Patient lived a Month after the Perforation of the Sternum, and Three Days after the opening of the Thorax.

GALEN is pleaſed to tell us, that he ordered the Sternum of a Boy, whoſe Portion was carious, to be cut off; ſeeing Part of the Pericardium corrupted, took it away alſo, and left the Heart quite naked; and yet the Boy ſoon recovered. Vid. De Anatom. Adminiſtrat. Lib. VII.

Profeſſor SPROEGLIUS ſays, he found the Pleura of a hanged Man callous, and ſome of the Glands (as he calls them) ſcirrhous; and the poſterior Part of the Pleura, which lined the Thorax, was like a Piece of Leather.

He alſo relates another Caſe of a Youth, in whom he found the inferior Part of the right Ventricle of the Heart half petrefied.

He likewiſe mentions the Caſe of another Youth, in whom he found the external Surface of the Pericardium full of a white Scirrhus, and ſome Places hard. As it was full of Pus, the Scirrhus cloſely adhered to the Heart; the inferior Part of the right Ventricle of the Heart was half petrefied with ſmall Stones, which adhered to the Pericardium; the two membranous Sinuſes of the Valves of the Aorta were callous, and partly petrefied, &c. Vid. HALLER. Opuſc. Pathol. Obſ. XLVIII & LII.

LECTURE XXII.

Of the SYSTOLE and DIASTOLE of the HEART*.

THE Heart is a Viſcus which has given the Learned a great deal of Trouble to find out its real Mechaniſm, and the true Cauſe of its regular Alternations of Contraction and Dilatation. I have oftentimes laid open the Thorax of a Dog, and kept his Lungs playing, with a Pair of Bellows, in order to obſerve how regularly and alternately the Syſtole and Diaſtole, both of the Heart and its Auricles, followed each other; that is, when the Ventricles were contracted, the Auricles were dilated, and vice verſa: So that the Auricles ſeem, in ſome meaſure, to act as Antagoniſts to the Ventricles; and the refluent Blood may be of the ſame Service to the Auricles.

But there being ſo great a Diſparity between the contractile Strength of the Ventricles and that of the Auricles, there muſt neceſſarily be ſome other Cauſe; which, when the Heart is fully contracted, makes it unbend again, or ceaſe to con-

* This LECTURE is taken from the ingenious Dr. BROWN LANGRISH's Third LECTURE, read before the ROYAL SOCIETY 1747. I do not know any Thing, that has been written on this Subject, more probable than this DISSERTATION.

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tract; by which means the Auricles, tho' ſo very weak in Compariſon of the Ventricles, have Power enough to throw in Blood, and thereby to diſtend the Ventricles to a certain Degree, before they are capable of acting again.

If we might be allowed to make an Eſtimate of the Difference between the contractile Strength of the Heart and its Auricles, from the Difference of their Bulk, or Number of Fibres, we ſhould find it to be about Nine to One; as I have obſerved, by weighing the Hearts of ſeveral Animals, and their Auricles, ſeparately.

Hence it does not ſeem reaſonable to think, that the weak Efforts of the Auricles would be ſufficient to cauſe the Diaſtole of the Heart, without ſome other Aſſiſtant.

One great Uſe of the Auricles is, to receive a Quantity of Blood, during the Syſtole of the Heart, ſufficient to fill the Ventricles again at their Diaſtole. The ſame may be ſaid, in ſome meaſure, of the Veins neareſt the Heart, which may be plainly ſeen to dilate during the Contraction of the Auricles; ſo that the Heart, Auricles, and Veins, have all their Syſtoles and Diaſtoles in ſubordinate Degrees.

Without ſuch Receptacles as theſe, it would be impoſſible for the Ventricles of the Heart to be filled from the Veins ſo ſuddenly as they are. For though the Areas of the tranſverſe Sections of the Veins are much larger than thoſe of the Arteries; yet we find, by Dr. HALES's Hæmaſtatical Experiments, that the Velocity of the Blood, in the Arteries, is above ſix to one to that in the Veins: But ſince the Auricles keep receiving the Blood, whilſt the Heart is in its Syſtole (the Veins doing the ſame by the Auricles), a due Quantity of Blood is always ready to be thrown into the Heart, by

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the Time it is fit to receive it: For the Diaſtole takes up two Thirds of the Space of Time between each Pulſe.

Here, then, we may obſerve, that the Momentum of the refluent Blood acts upon, and diſtends, the Veins neareſt the Heart, whilſt the Auricles are contracted; that it alſo dilates the Auricles whilſt the Heart is in Action, and that the Heart is in its Diaſtole whilſt the Auricles are in their Syſtole.

But the great Difficulty, in accounting for the Diaſtole of the Heart, is, from the Diſproportion between its contractile Power and that of the Auricles; it being plain, from what has been ſaid above, that the Momentum of the Blood in the Veins is ſtopped by the Contraction of the Auricles; ſo that the Ventricles of the Heart can receive no other Impulſe from the Blood, at that Time, than what is derived from the Contraction of the Auricles.

Hence, therefore, it follows, that if the Syſtole was the natural State of the Heart, and to which it always tended with its full contractive Power; the Impulſe of the Blood, from the Contraction of the Auricles, could never be able to dilate it.

Dr. LOWER makes the Syſtole the natural State or Action of the Heart, and the Diaſtole the violent one; BOERHAAVE, on the contrary, makes the Syſtole the violent one, and the Diaſtole the natural State: But perhaps neither of theſe Opinions may be right, in the ſtricteſt Senſe. For, if we look back, we ſhall find, that, if the Fibres were not tenſe, they could not be elaſtic; and if ſome Violence was not put upon them, by the Impulſe of the circulating Fluids, they would not be tenſe. Hence it appears, that Elaſticity proceeds from a State of Violence.

And

And again; when a Muſcle is freed from the Power of its Antagoniſt, and thereby left at full Liberty to contract, as it always will by its elaſtic reſtitutive Power only; it does ſo no farther than in Obedience to the common Power of Attraction between its component Particles: But in all other muſcular Action, when this attractive Power is greatly increaſed by the Influx of the nervous Æther, the Contraction is carried much farther, and the Muſcle more fully contracted than it ever is in the other State. Hence it follows, that Contraction, in its fulleſt Degree, is not the natural State of a Muſcle.

And farther; when the conſtituent Particles of the Fibres are drawn into their cloſeſt Contacts, by the Influx of the nervous Æther, it requires ſome Force, in a contrary Direction, to elongate the Fibres again: So that Extenſion, or Dilatation, is alſo a State of Violence.

From the Whole, then, it appears, that neither the Syſtole nor Diaſtole, in a full Degree, is the natural State of the Heart; and this we ſhall ſhew more plainly hereafter, by inſpecting the Hearts of Animals which have been bled to Death. But to proceed:

From what has been ſaid above, it ſeems reaſonable to conclude, that if Contraction, in its fulleſt Degree, was the natural State of Reſt or Quieſcence in the Heart, the Momentum of the Blood, from the Contraction of the Auricles, could not be a ſufficient Counterpoiſe. And ſince ſo many fruitleſs Attempts have been made to account for the Diaſtole of the Heart, from the Impetus of the Blood in the Veins, and from the Preſſure of the Atmoſphere, &c. give me Leave to propoſe the following Queries:

1. May not the Heart be a compounded Muſcle; that is, may it not have its Antagoniſt within itſelf?

itſelf? Or, in other Words, Are not ſome of its Fibres ſo ranged, that, whilſt one Set of them is contracted and ſhortened, others may be ſtretched out; analogous to the Action of the intercoſtal Muſcles, or any other Muſcles, with their Antagoniſts?

2. Is the nervous Æther tranſmitted from the Brain to the Heart, in a pulſatory Manner, at equal Diſtances of Time; or may it be ſuppoſed to move uniformly through the Nerves, and ſome Interruption is given to its Influx into the muſcular Fibres, when the Heart is in its Syſtole?

3. Does not the Diaſtole of the Heart depend upon an Abatement of the Tenſion in the contracted Fibres; a Motion of Reſtitution in ſuch as are over-ſtretched, and the Influx of the Blood, conjunctly?

Without ſome ſuch Mechaniſm as this, no Power that we know of, belonging to the animal Oeconomy, would be able to cauſe the Diaſtole of the Heart: But if ſuch a Structure, as is above mentioned, could be proved; no more Difficulty would attend the Explication of it, than that of the voluntary Muſcles.

In diſſecting the Heart, we find a great many different Orders or Series of Fibres, variouſly contorted, and running in contrary Directions: So that, for ought we know, it may be an Epitome of muſcular Conſtruction in general.

We may here obſerve what Care Nature has taken to prevent too great a Dilatation in the Diaſtole of the Ventricles, the right one eſpecially, as being the weakeſt, by forming the Papillæ, or Columnæ, which run from the Septum, or middle Partition, to its oppoſite Sides; whereby they act as ſo many Braces in the Diaſtole; and when they contract, they alſo aſſiſt in the Syſtole. And perhaps it may not be the moſt improbable Conjecture

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to think, that as much Care may have been taken in providing a ſufficient Number of Fibres, or little Muſcles, which may be ſo formed as to act, in the Diaſtole, as Antagoniſts to thoſe which occaſion the Syſtole.

The Hearts of Frogs, Vipers, Eels, &c. ſeem to evince the Reaſonableneſs of this Conjecture, by continuing their Syſtoles and Diaſtoles after they are taken out of the Body, when there is no refluent Blood to dilate the Ventricles; and, conſequently, if there were no Fibres upon the Stretch, when the Heart is contracted, which, by their Elaſticity, or reſtitutive Power, did pull back or elongate ſuch as were contracted; there could not poſſibly be any Diaſtole in ſuch Circumſtances.

We are aſſured by Mr. Boyle, in his Phyſico-Mechanical Experiments, that the Heart of an Eel hath continued to beat an Hour, in an exhauſted Receiver; after which, finding its Motion very languid, and almoſt ceaſed; by breathing a little upon that Part of the Glaſs where the Heart was, it quickly regained Motion; and, an Hour after that, finding it almoſt gone, he was able to renew it, by the Application of a little more Warmth.

The ſame illuſtrious Author farther aſſures us, that he has ſometimes cut the Heart of a Flounder tranſverſly into two Parts; and freeing each from the Blood it contained, he obſerved, for a conſiderable Time, that both of them together continued their former Contraction and Relaxation. And once, thus cutting one into ſeveral Pieces, he found, to his Surprize, that they not only moved as before, but that even the Whole, thus ſeparated, long preſerved the ſame Succeſſion of Motion, as appeared therein whilſt coherent.

Now can the Diaſtole of the Heart, in theſe Experiments, be accounted for upon any other

Principles than thoſe we have laid down? Here was no Impulſe, from the refluent Blood, to dilate the Auricles, or diſtend the Ventricles: The Preſſure of the Atmoſphere was alſo quite taken away in the firſt Experiment, and could not poſſibly be of any Service in the laſt; and yet the Diaſtole continued.

Can the ſame Fibres, which are contracted, have it in their own Power to fly out again to their uſual Lengths? If this cannot be, what Power is there in a Heart, taken out of the Body, to unbend itſelf, or dilate its Ventricles, after they are once contracted, unleſs we ſuppoſe ſome of its Fibres to act as Antagoniſts to others?

We have good Reaſon therefore to believe, that ſome Fibres of the Heart are always ſtretched out beyond their natural Tone, when others are contracted; ſo that, by their elaſtic reſtitutive Property, they do act as Antagoniſts, in a certain Degree.

In regard to the Syſtole, in ſuch Hearts as are taken out of the Body, and cut into ſeveral Pieces, we conceive, that as long as Warmth and Moiſture remain, ſo long may the æthereal Matter in the Nerves continue to fly into the Fibres, and contract them; and, when it ceaſes, more Warmth, or a gentle Impulſe (even with the Point of a Needle only), will revive the Motion.

Hence we may, in ſome meaſure, diſcover the amazing Subtilty of the nervous Æther; when ſuch very ſmall Sections of the Nerves, as in the abovementioned Experiment upon the Heart of a Flounder, ſhould contain Matter ſufficient for ſo many Contractions.

Let us now return to our ſecond Query, and examine whether the nervous Æther is tranſmitted from the Brain to the Heart, in a pulſatory Manner, at equal Diſtances of Time; or whether ſome

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Interruption is only given to its Influx into the muſcular Fibres, when the Heart is in its Syſtole?

In order to underſtand this, we muſt look back and conſider, that, according to our Theory, if the æthereal Medium in the Nerves was perpetually flying into the muſcular Fibres of the Heart, it would be conſtantly contracted, notwithſtanding the Momentum of the Blood, the Contraction of the Auricles, or the Vis Reſtitutionis in the ſtretched-out Fibres. Hence then it is evident, that the alternate Contractions and Dilatations of the Heart proceed from an alternate Influence of the nervous Æther; but how this Alternation happens, when the Nerves which ſupply the Heart are not, in the leaſt, under the Direction of the Will, is the Difficulty we labour under.

In all the Nerves which ſupply the voluntary Muſcles, it is certain there are Reſtrictions in ſome Parts of them which the æthereal Matter is not able to dilate without an additional Impulſe from the Will; or otherwiſe Cramps and Convulſions would perpetually happen. But in thoſe which ſupply the Heart, the Motion of the Æther thro' them cannot have any Aſſiſtance or Impulſe from the Will, as not being in the leaſt under its Influence; ſo that the Vibrations of the Meninges of the Brain, and the Dilatations of the Arteries, may be ſuppoſed to be the Agents which propel the Æther towards the Heart.

Hence then it ſeems to follow, that the alternate Contractions of the Heart may proceed from the alternate Impreſſions made on the Nerves by the Meninges of the Brain, and Dilatations of the Arteries.

Upon opening the Skulls of living Animals, the Dura Mater may plainly be ſeen to have its Syſtoles and Diaſtoles correſponding to thoſe of the Arteries: But ſince the Heart continues to beat after

after the Head is cut off, or even after it is taken out of the Body, where there cannot be any alternate Succuſſions made on the Nerves by the Meninges of the Brain, or the Pulſation of the Arteries; it ſeems reaſonable to believe, that this Alternation is occaſioned by ſome Impediment being given to any farther Influx of the Æther into the muſcular Fibres of the Heart, when it is fully contracted; or, otherwiſe, the Heart would conſtantly remain in a State of Contraction, as long as there was any æthereal Matter flying from the Nerves.

If we conſider in how many different Directions the muſcular Fibres of the Heart run, how much they are corrugated, thickened, and ſwelled, when fully contracted; and how ſtrong and uniform the Preſſure muſt be in their greateſt Degree of Action; it may not perhaps appear unreaſonable to think, that the Extremities of the Nerves, which are inſerted into every Fibre, and which are extremely ſmall and tender, may be preſſed upon and ſqueezed, ſo as to prevent the Influx of the Æther, till the Preſſure is abated, or till the Fibres are extended again to their uſual Lengths.

What ſeems to evince the Reaſonableneſs of this Suppoſition is, the Nature of the Shaking Palſey; where the voluntary Muſcles immediately become involuntary ones; ſo far, at leaſt, as to be alternately contracted and relaxed without the Conſent or Direction of the Mind.

Now this Diſtemper we believe to proceed from a particular Weakneſs in the Nerves, whereby thoſe little Reſtrictions in them, which keep the æthereal Matter within due Bounds, in a State of Health, are ſo far weakened and deſtroyed, that the Æther has a Power of flying into the muſcular Fibres without any Impulſe or Direction from the Will, after the ſame Manner it does into the Heart.

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If, therefore, no Interruption was to be given to the Influx of the nervous Æther by the Muſcles themſelves, when they were contracted, it would follow, that if the Flexors of any Extremity were to be firſt contracted, the Extenſors would not be able to recover the Æquilibrium, and to be contracted, in their Turn, without the Aſſiſtance of the Will. For if our Doctrine be right; viz. that muſcular Motion proceeds from the conſtituent Particles of the Fibres being drawn into cloſer Contacts by the attractive Influence of the nervous Æther; it neceſſarily follows, that if the ſame Quantity of Æther was continually to fly into a Muſcle already contracted, it would have a greater Influence on the component Particles, ſo approximated, than on others, in the antagoniſt Muſcles, which are contracted; and, conſequently, touch each other in fewer Points.

Hence it ſeems to be evident, that ſome Impediment is given to the Influx of the nervous Æther when the Muſcles are contracted; or, otherwiſe, they would always remain ſo: For tho' the Will may be able to remove ſuch little Impediments, and keep the voluntary Muſcles in a State of Contraction, for a conſiderable Time; yet, ſince the voluntary Muſcles, when affected with a Palſy, are regularly and alternately contracted, and have their Syſtoles and Diaſtoles analogous to the Heart and its Auricles; I think we have good Reaſon to conclude, that the ſame Principles which contract and dilate the voluntary Muſcles, in the abovementioned Condition, are the Principles which occaſion the Syſtole and Diaſtole of the Heart; with this Difference, only, that the Influx of the Blood into the Sinuſes of the Heart, is what no other Muſcle in the Body has, or receives: And, without doubt, this may truly be reckoned the greateſt Aſſiſtant in dilating the Ventricles of

the Heart, after the attractive Influence of the nervous Æther ceaſes, and the Æquilibrium is reſtored between the ſtretched-out Fibres and thoſe which were contracted.

What has been ſaid ſeems greatly to evince the Truth of our third and laſt Suppoſition; viz. that the Diaſtole of the Heart may depend on an Abatement of Tenſion in the contracted Fibres, a Vis Reſtitutionis in ſuch as are over-ſtretched, and the Influx of the Blood, conjunctly.

Give me Leave to relate two or three Experiments, which I have made, in order to illuſtrate the foregoing Theory, and then I ſhall conclude.

Experiment I.

Having obſerved, that the Ventricles of the Hearts of all Animals, when bled to Death, are dilated, or ſtand wide open to a certain Size, tho' there happens to be very little Blood in them; it ſeems as if the Diaſtole, in a certain Degree, was the laſt Motion of the Heart.

In order to know the Truth of this, I opened the Thorax of a Dog, and kept his Lungs playing with a Pair of Bellows, that I might perfectly ſee the ſeveral Actions of the Heart and its Auricles.

The Auricles ſeemed to me to begin the Motion, and the Syſtole of the Heart always inſtantly followed that of the Auricles; then the Apex and Sides of the Heart ſunk down, and were lengthened, of their own Accord, before any Blood was thrown into the Ventricles, from the Contraction of the Auricles; for there was oftentimes more than double that Time taken up in the Diaſtole of the Heart, than in the Syſtole, which the Auricles and Ventricles required.

If I deſiſted from blowing freſh Air into the Lungs for ſome little Time, the Heart would lie ſtill;

ſtill; and yet I could recover its Motion again, by ſtrongly diſtending the Lungs. In this Action I never could diſcern that the Heart began the Motion, but the Auricles always contracted firſt, and then the Heart immediately afterwards; though, at laſt, I ſaw ſeveral Contractions of the Auricles, which were not ſucceeded by any Motion of the Heart.

I muſt not forget to mention, that, in another Dog, I ſaw ſeveral Syſtoles and Diaſtoles of the Heart, after I had purpoſely cut aſunder both the Venæ Cavæ; and could plainly perceive the Ventricles to relax and open themſelves, when very little or no Blood could poſſibly flow into them. This, however, is much more eaſily ſeen in the Heart of a Viper, when taken out of the Body, which will continue its Syſtole and Diaſtole for a long Time; and if it ceaſes to beat ever ſo often, and you renew its Motion again and again, by breathing upon it, &c. you may obſerve, that the Auricle always contracts before the Ventricle; and that the Diaſtole is the laſt Motion, though there is no Blood to diſtend the Heart.

The Capacity of the right Ventricle of the Dog's Heart, in the above Experiment, as it opened of its own Accord, was ſomewhat more than a cubic Inch; as I found, by pouring in melted Wax from a Ladle, without any Preſſure from a perpendicular Height, after the Auricle and Blood Veſſels were cut off tranſverſly.

Experiment II.

Taking the Heart out of an Ox as ſoon as I poſſibly could, after he was killed, and having cleanſed it from the Blood, by waſhing it in warm Water; I filled both the Ventricles with melted Wax, without any diſtending Force more than by pouring it from the Ladle: The Heat of the

Wax ſeemed rather to contract the Fibres, and leſſen the Capacities of the Ventricles; for ſome of the Wax kept running out from the Heart after I had done pouring it from the Ladle.

The Capacity of the right Ventricle was equal to 5 cubic Inches and a Half; the Capacity of the left was not quite 5 cubic Inches.

From theſe Experiments it manifeſtly appears, that the laſt or reſtitutive Motion of the Heart is, to dilate or open the Ventricles, and that without any Aſſiſtance or Impulſe from the refluent Blood.

Dr. HALES * injected the left Ventricle of the Heart of an Ox from a Column of melted Wax 4 Feet and a Half high, which diſtended the Capacity of it to 12 cubic Inches and a Half. Now ſuppoſing the Impulſe of the refluent Blood to be equal to a Column of melted Wax 4 Feet and a Half high, and that in every Diaſtole, whilſt the Ox was alive, the left Ventricle was diſtended to the Capacity of 12 cubic Inches and a Half; yet we may obſerve, that the Heart, immediately after each Syſtole, relaxes and dilates its Ventricles to a certain Degree, by its own Mechaniſm; and to whatever Capacity the Ventricles are afterwards dilated, it muſt neceſſarily proceed from the Impulſe of the Blood only; all which is perfectly agreeable to our third Query; viz. that the Diaſtole of the Heart may depend upon an Abatement of the Tenſion in the contracted Fibres, a Motion of Reſtitution in ſuch as are over-ſtretched, and the Influx of the Blood conjunctly.

EXPERIMENT III.

I took the Heart out of a live Viper, and placing it upon a Piece of writing Paper, I found it

* Hæmaſtatics, p. 25.

beat

beat at the Rate of 24 or 25 Pulſations in a Minute, for three or four Minutes: After this, I laid the Paper upon the Palm of my Hand, the Warmth of which increaſed the Number of Pulſes to 37 the firſt Minute, and 48 the ſecond. Laſt of all, I put it into warm Water, a Degree or two warmer than the Blood, where it beat 87 Pulſes the firſt Minute, and afterwards declined in its Motion, more and more, till it quite ceaſed.

May we not from hence obſerve, what vaſt Influence Heat had upon the nervous Æther to make it fly ſo quick into the Heart as to increaſe the Pulſe to almoſt four Times their uſual Number? How far the Heat, in ſome ſort of Fevers, may quicken the Pulſe, is not to our preſent Purpoſe to enquire.

It is amazing to think, that ſuch very ſmall Portions of the Nerves, as were cut out with the Heart in this Experiment, ſhould contain Matter ſufficient for ſo many Contractions; and that it did not all of it inſtantly fly out from the wounded Ends, even before it was put into warm Water.

Observations.

The Pulſe is, therefore, the Meaſure of the Powers which the Heart ſpends on the Blood; becauſe it is the immediate and full Effect of thoſe Powers. Hence, all Things conſidered as alike, the Pulſe is ſlow in the moſt healthy People, where there is no Stimulus, nor any unnatural Reſiſtance to cauſe the Effect of a Stimulus; but the Heart is at Liberty to ſend forwards the Blood with Eaſe.

A large Pulſe is cauſed by Fulneſs of the Artery, joined with a ſtrong Force of the Heart: But a hard Pulſe denotes ſome Obſtacle or Stimulus; or elſe, that the Heart's Force is increaſed with a greater Thickneſs of Blood, or a greater

Rigidity of the Artery. A quick Pulſe denotes ſome Stimulus, or Obſtacle, or greater Senſibility or Irritability of the Heart.

It is beſt felt where the Artery lies expoſed bare to the Touch upon ſome reſiſting Bone; but Obſtructions ſometimes render the Pulſe perceptible where it is never ſo naturally.

The Pulſe is ſlower in Animals as they are larger, or more bulky; becauſe the Heart is proportionably bigger in the ſmaller than in the larger Animals, and becauſe the Heart is obliged to drive the Blood to a greater Diſtance; whence the Reſiſtances, or Frictions, ſeem to be increaſed, in the more bulky, over the Force of the Heart. Hence ſmall Animals are more voracious, and large ones, as the Whale and Elephant, eat leſs.

The Pulſe of a healthy Perſon, riſing in the Morning, beats 65 Times in a Minute; but, after the Fatigue of the Day, it will, in the Evening, beat 80 in the ſame Time: And, again, by the Night's Reſt, or Sleep, it will become gradually ſlower, till, in the Morning, you will find it returned again to its primitive Number 65. For the voluntary Motion of the Muſcles, and Actions of the external and internal Senſes, urge the venal Blood on to the Heart; which, being thereby often ſtimulated, makes more frequent Contractions.

This is the Cauſe of thoſe Paroxyſms or Fits of Increaſe, obſervable in all Fevers towards the Evening. For Sleep not only retards the Motion of the Blood, but of all the other Humours and Actions in the Body whatever.

Dr. HALES ingeniouſly obſerves, that the Pulſe is quicker in ſmall Animals, and ſlower in larger. In his Hæmaſtatics, he found the Pulſe of a Horſe ſlower, by Half, than in a Man; viz. 32 Pulſations, only, in a Minute; whereas, in a Dog, the Pulſe beat 97 Times in the ſame Space, and in a Sheep

Sheep 65; that is, about the same Number as in a Man sleeping.

This, we find, is conformable to the Heat of the Blood, as measured by the Scale of FARENHEIT's mercurial Thermometer, as the late Dr. GEORGE MARTIN has ingeniously observed.

For the Blood in Oxen, Horses, and other large Animals, at Rest, being five or six Degrees cooler than in Man, will not rise to our Heat, that is, 96 Degrees, but by a tolerable Degree of Exercise or Labour, which they can thus better endure: Whereas Dogs, Cats, and Fowls, are five or six Degrees hotter than Men; and the latter, when sitting on their Eggs for Young, are still four or five Degrees hotter, that is, 107 or 108 Degrees, which is commonly the Heat of our Blood in a Fit of the Ague; where it is observable, that, during the greatest Sense of Cold, the Blood is three or four Degrees hotter than in Health; after which, it gains four or five Degrees more in the Height of the hot Fit; viz. 104 or 105 Degrees: But, in violent ardent Fevers, where the Pulse beats 140, the Blood's Heat will still be four or five Degrees higher, viz. 110; that is, two or three more than equal to a sitting Hen or Pigeon, and within three Degrees of the Heat that scalds a delicate or tender Hand.

But such a Heat is in no Danger of hardening, but of putridly dissolving the Blood or Serum, which BOERHAAVE mistook, in his Chemistry: For to indurate Serum, or the Whites of Eggs, takes near 90 Degrees more of Heat.

Nor is the pleuritic or inflammatory Crust caused by a greater Heat, but from a greater Stagnation of the Blood in some Vessels, whilst it returns faster through others; by which the lymphatic and serous Globules, with the nutritious Glue, retaining less Motion from their less Density, run into filamentary Concatenations and Cohesions.

The Pulſe is more quick or frequent in Children as they are younger, and becomes afterwards ſlower in Perſons as they grow older. The ſalient Point of an Ovum beats 134 Times in a Minute; the Pulſes of new-born Infants beat 120 in the ſame Space of Time; and from thence, down to old Age, it grows ſlower, to 60 in a Minute.

A feveriſh Pulſe begins from 96 per Minute; and we reckon the Pulſe has but a moderate Celerity in Fevers, or laborious Exerciſes of adult Perſons, if it does not exceed 110 or 120 in a Minute; but it is exceſſive at 130 or 140, which is the Number of Pulſes with which a Man dies.

The Pulſe beats ſlower in Winter, and quicker in Summer, by about 10 Strokes per Minute; and under the Torrid Zone it grows quicker, to 120. The different Paſſions of the Mind variouſly accelerate, retard, and diſturb, the Pulſe.

We are to obſerve, that the Blood's Heat, or Velocity, are neither of them in Infants, in all Caſes, proportionable to the Quickneſs of the Pulſe; but the Denſity or Proportion of Craſſamentum in the Blood, with more Magnitude of the Pulſe, or Diſtenſion and Elaſticity of the Arteries, muſt concur; the Defect of which is a Balance to the great Celerity of the Pulſe in Infants, which would otherwiſe be the Cauſe of a high Fever in them, as well as in Adults. As they generate their Blood themſelves, when in the Uterus, and receive none from the Mother (as ſome thought), the largeſt Globule which creates the Heat, and is the Cauſe of Elaſticity of their Veſſels, are at firſt inconſiderable; and as theſe advance by Age, the Celerity of the Pulſe abates; whence Heat, and Velocity of the Blood, are continued nearly the ſame. Dr. MIHLES on HALLER's Phyſiology.

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LECTURE XXIII.

Of the Force of the HEART, Contraction of the ARTERIES, Gravity and Attraction of the CAPILLARY TUBES, considered as Cauſes of the Circulation of the Fluids in the ſmall Veſſels of Animals *.

THE principal Cauſe which propels the Blood through the Veſſels, is, without doubt, the Contraction of the Heart. Let us then, firſt, enquire, How far this may be ſuppoſed ſufficient to account for the Motion of the Fluids in the very ſmall Veſſels of Animals?

If the Force with which the Blood is thrown, by the left Ventricle of the Heart, into the Aorta, be ſuppoſed equal to the Preſſure of a Column of Blood 90 Inches high †, the Momentum of this Fluid, in an Artery, will be found, by multiplying the Area of the tranſverſe Section of that Ar-

* This Eſſay I found ſo ingenious and probable, that I could not help extracting it from the learned WHYTT's Phyſiological Eſſays.

† Dr. HALES, from a Variety of Experiments made on Horſes, Dogs, Sheep, and other Animals, thinks it probable, that the Blood would riſe ſeven Feet and a Half, or 90 Inches, in a Tube fixed into the carotid Artery of a middle-ſized Man. Statical Eſſays, Vol. II. p. 40.

tery

tery into 90, the Height of that Column of Blood, whose Pressure is supposed equal to the protrusive Force of the Heart; for the Product gives the Number of cubic Inches, or Parts of a cubic Inch, of Blood, whose Weight is equal to the pressing Power with which the Blood is driven, by the Force of the Heart, into that Artery.

The Diameter of a circulating red Globule of Blood has been generally reckoned somewhat less than a three Thousandth Part of an Inch; but Dr. MARTIN has, from LEWENHOECK's and JURIN's later Observations, shewn it to be $\frac{1}{1933.5}$th Part of an Inch*: And LEWENHOECK has observed, that one of these Globules is sometimes obliged, in passing through a very small capillary Artery, to change its Figure into an oblong Spheroïd; so that the Diameter of such an Artery may be supposed nearly equal to that of a red Globule. If, then, for the Sake of a more easy Computation, we suppose the Diameter of a red capillary Artery to be equal to a two Thousandth Part of an Inch; the Area of its transverse Section will be equal to 0.000000196; and this, multiplied by 90, gives 0.0000176 Parts of a cubic Inch of Blood; which amounts to 0.00466 or the 214th Part of a Grain†; and is equal to the Moment of the Blood arising from the Force of the Heart, in a capillary Artery whose Diameter is the two Thousandth Part of an Inch; upon a Supposition that there were no Loss of Motion from Friction, and that the Areas of the transverse Sections of all the capillary Arteries in the human Body were equal to that

* Medical Essays, Vol. II. Art. VII.

† A cubic Inch of warm Blood is reckoned, by some, to be 266; and, by others, a little more than 267 Grains: But Dr. MARTIN seems to have fixed it, pretty accurately, at 264 three Fourths; and, for the Sake of even Numbers, I have supposed it to be 265 Grains.

of

of the Aorta. But since this is not the Case, and the Areas of the former greatly exceed that of the latter; the Moment of the Blood, in a capillary red Artery, will fall very much short of our Computation.

To illustrate this; Let us suppose a Pipe *A*, of an Inch Diameter, to be divided into several Branches, and at last to terminate in 10000 small Tubes *a*, *a*, *a*, *a*, &c. each a Hundredth Part of an Inch in Diameter, the Sum of the Areas of whose transverse Sections is equal to that of *A*: If a Fluid be pushed through such a System of Vessels, with any given Force, the Velocities in the small Tubes *a*, *a*, *a*, *a*, &c. will be equal to the Velocity in *A*; and their Momenta *m*, *m*, *m*, *m*, &c. all taken together, will, allowing for Friction, be just equal to the Momentum *M*, in the large Trunk *A*; i. e. m 10000 $= M$, or $m = \frac{M}{10000}$. But if another Pipe *B*, of the same Diameter with *A*, be divided so as to terminate in 300000 small Tubes *b*, *b*, *b*, *b*, &c. each a Hundredth Part of an Inch in Diameter; then, altho' a Fluid be pushed through the two Trunks *A* and *B* with the same Velocity, and, consequently, the Momentum in them be equal; yet the Velocity, in any one of the small Tubes *a*, *a*, *a*, *a*, &c. will be to the Velocity in any one of the corresponding Tubes *b*, *b*, *b*, *b*, &c. as 30 to 1; and, consequently, their Momenta will be as 900 to 1.

Dr. KEILL having, by measuring the Arteries of the human Body, fixed the Proportions of the Branches to their Trunks after every Division, lays down a Method of calculating in what Degree the Velocity of the Blood, in the different Arteries, is affected by the Increase of the Capacity of the Vessels through which it flows*. According to

* KEILL's Tentamen Med. Phys. 2.

this

this Computation, it will be found, that the Velocity of the Blood, in an Artery whose Diameter is a two Thousandth Part of an Inch, ought to be to its Velocity in the Aorta, as 1 to 345; and, consequently, the Moment of the Blood, in such an Artery, must be 345 multiplied by 345, equal to 119025 Times less than we have computed it above; i. e. $= \frac{1}{214} \times 119025 = \frac{1}{25471350}$ Part of a Grain. And since a Globule of red Blood weighs nearly $\frac{1}{500000000}$ Part of a Grain*, it follows, that the Moment, or pressing Force, of such a Globule in its capillary Artery, arising from the Impulsion of the Heart, does not exceed twice its own Weight.

But even this Moment, however small it may appear, must be diminished by Friction; the precise Quantity of which, although it may, perhaps, be difficult, with any Certainty, to determine; yet, that it must be very considerable, will evidently appear, from what follows.

If two Pipes, of equal Lengths, whose Diameters are $\frac{373}{1000}$ and $\frac{90}{1000}$ Parts of an Inch, be, one after another, screwed into the Side of a Vessel at the perpendicular Distance of four Feet from the Top of the Water, and laid parallel to the Horizon; the large Pipe will discharge 179, and the small Pipe $6\frac{1}{8}$ Ounces of Water, in Half a Minute. Hence the Velocities of the Water, in these two Pipes, must have been as 1293 and 756; and, were it not for the Inequality of the Resistance of the Air, the Velocity in the large Pipe would have been still greater, and the Velocities in the two Pipes very nearly as the Square Roots of their respective Diameters†.

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* Medical Essays, Vol. II. Art. VII. § 11.

† Robinson's Animal Oeconomy, Prop. I. Exp. 2.

Hence,

Hence, if we could ſuppoſe a capillary Artery, of $\frac{1}{2000}$ Part of an Inch Diameter, to go off directly from the Beginning of the Aorta, without any intermediate Branchings; the Velocity of the Blood in it would be, cæteris paribus, to the Velocity of the Blood in the Aorta, nearly, as $\sqrt{\frac{2}{0.0005}}$, the Diameter of the capillary Artery, is to $\sqrt{\frac{2}{0.7}}$, the Diameter of the Aorta, i. e. as 1 to 37.4; and, conſequently, the Moment of a ſingle Globule in ſuch a capillary Artery, would be to its Moment in the Aorta, as 1 to 1398.

But farther: The Loſs of Motion from Friction depends not only upon the Smalneſs of the Veſſels, but alſo upon their Diſtance from the Heart. For if two cylindrical Pipes, whoſe common Diameter is $\frac{345}{10000}$ Parts of an Inch, and whoſe Lengths are 2 and 8 Feet, be ſcrewed into the Sides of a Veſſel full of Water, at the Diſtance of four Feet from the Top; the Quantities diſcharged in Half a Minute will be $97\frac{1}{2}$ Ounces by the long Pope, and 175 Ounces by the ſhort one. Hence the Velocities of the Water, in the two Pipes, were as $97\frac{1}{2}$ and 175; ſo that, by the greater Quantity of Friction in the longeſt Pipe, the Water loſt above $\frac{2}{5}$ of its Velocity *.

Again; the Velocity of the Blood will be different, according to the different Angles at which the Branches go off from their Trunks, and the Flexures and Convolutions of the ſmall arterial Ramifications muſt increaſe the Friction in them, and, conſequently, retard the Motion of the Blood conſiderably. This ſeems to be confirmed by an Experiment of Dr. HALES; from which it appears, that the Velocity of the Blood, in the ſmall Arteries, decreaſes in a greater Proportion than it

* Ibid. Prop. I. Exp. 1.

ought

ought to do, by the above-mentioned Experiments made with ſtrait cylindrical Pipes. For having ſlit up the Inteſtines of a Dog from one End to the other, on the Side oppoſite to that where the Blood Veſſels enter them, and fixed a Braſs Tube into the deſcending Aorta; he found, that, with a Preſſure equal to the Force of the Heart, only $\frac{1}{3}$ of the Water paſſed, in a given Time, through the ſlit Arteries of the Inteſtines that flowed thro' the Meſenteries, when cut over juſt at their Entry into the Guts; notwithſtanding the Areas of the Orifices of all the former exceeded that of the latter, and the Diameters of the cut Meſenteries did not exceed four Times the Diameters of the converging ſlit Arteries of the Guts*.

From what has been ſaid it may appear, that the Velocity of the Blood will not be the ſame in all the Arteries of the ſame Diameter (as ſome have fondly imagined, and been at no ſmall Pains to prove); but will be greater or leſs, according to their Diſtance from the Heart, the Exceſs of the Areas of the Branches above their Trunks, the Angles at which they go off, and the Number and Degree of their Flexures.

Agreeably to this, Dr. HALES obſerved, that, in a capillary Artery of the Lungs of a Frog (where the Diſtance from the Heart is but ſmall, and the Exceſs of the Areas of all the Branches above their Trunk is not near ſo great as in the other Parts of the Body), the Blood moved 43 Times faſter than in a capillary Artery of one of the Muſcles of the lower Belly†. And it is probable, that, next to the Lungs, the Blood moves quickeſt through the Veſſels of the Heart. In

* HALES's Statical Eſſays, Vol. II. Exp. IX.
† Ibid. p. 68.

Con-

Conſequence of this quick Circulation, it muſt be evident, whether we ſuppoſe animal Heat to ariſe from the Friction of the Blood upon the Sides of the Veſſels, or from an inteſtine Motion among its ſmall Particles, that, cæteris paribus, more Heat muſt be generated in the Lungs and Heart than any-where elſe; and hence the Neceſſity of continual Supplies of freſh Air to cool the Blood in its Paſſage through the pulmonary Veſſels.

Nor is this Opinion founded on Theory alone: For, upon Trial, it will appear, that the greateſt Heat in any Animal is, almoſt always, about the Heart.

In a Jackdaw the Heat below the Wing made the Mercury in my Thermometer riſe to 104 Degrees of FARENHEIT's Scale; within the Inteſtinum Rectum it roſe to $107\frac{1}{2}$; and, when applied to the Heart, it reached 109. And, agreeably to this, I have found the Heat in a Pigeon's Heart above a Degree greater than that within the Inteſtinum Rectum.

Upon the Whole, if the Moment of a ſingle red Globule of Blood, ariſing from the preſſing Force of the Heart, does not, in its capillary Artery, even abating Friction, exceed twice its own Weight, or $\frac{1}{25471350}$ Part of a Grain; and if that Loſs of Motion, which it muſt have ſuſtained by Friction, in its Way from the Heart thither, be conſiderable, as one may reaſonably conclude, from what has been advanced upon this Head; it will follow, that the real remaining Force of ſuch a Globule, when it arrives at a red capillary Artery, may, probably, fall ſhort of its own Weight; and muſt be ſo extremely ſmall, that it can ſcarcely be ſuppoſed ſufficient to overcome the Reſiſtance it muſt meet with in paſſing through a Veſſel by which it is cloſely embraced on all Sides, although

the anterior Fluid in the capillary Veins were no Obſtacle in its Way.

I deſire it may be here underſtood, that the above Calculations are by no means intended as Demonſtrations, but rather as Illuſtrations, in the preſent Argument concerning the Force of the Blood in the ſmaller Veſſels: And, allowing that by them the Moment of a red Globule, in its capillary Artery, comes out too ſmall, either from our having, with Dr. HALES, rated the general Force in the left Ventricle of the Heart too low; or, with Dr. KEILL, the Number of Branchings of the Arteries, and the Proportion they bear to their Trunks too high: Yet it muſt be evident, that, in the inferior Orders of Veſſels, the Fluids cannot be propelled by the Power of the Heart; or, which is the ſame Thing, that the left Ventricle of the Heart does not, by its direct projectile Force at every Contraction, puſh on and move forwards the whole circulating Fluids in all the Veſſels of the Body.

Dr. HALES * obſerved the Blood's Motion accelerated by every Syſtole of the Heart, not only in the ſmall Arteries, but alſo in the naſcent capillary Veins, of the Lungs of a Frog; and LEWENHOECK aſſures us, he has ſeen the ſame Thing in other Parts of various Animals: So that it is not to be doubted, that the projectile Force of the Heart reaches, at leaſt, as far as the capillary Arteries of the firſt Order; nay, is probably continued, for ſome ſmall Way, along their correſponding Veins; eſpecially when theſe are not far from the Heart.

* Statical Eſſays, Vol. II. p. 69.

But

But that the Moment of the Blood in the red capillary Arteries, at any conſiderable Diſtance from the Heart, muſt be very ſmall, will appear, from an Obſervation of Dr. HALES; according to which, the Velocity of the Blood in one of theſe Arteries, in the Abdomen of a Frog, was near 900 Times leſs than the equable Velocity of this Fluid in the Aorta of a Man*; and, conſequently, 2.6 Times leſs than we have computed it to be in a human red capillary Artery: Wherefore the Exceſs of the Moment of a red Globule, in ſuch an Artery of a Frog, above the Reſiſtance it had to overcome, only amounted to $\frac{1}{1734000}$ Part of a Grain; and ſo muſt have fallen a good deal ſhort of $\frac{1}{3}$ of its own Weight, ſuppoſing the Globules of red Blood in a Man and a Frog to be of the ſame Magnitude; which does not ſeem improbable†.

If, then, the remaining Moment of a red Globule of Blood in its capillary Artery, after having overcome the Reſiſtance of the Blood in its correſponding Vein, does not amount to $\frac{1}{3}$ of its own Weight; it muſt be evident, that the ſerous and ſmaller Globules, which move along with the red ones, muſt be applied, by the projectile Force of the Heart, to the Orifices of the lateral ſerous Arteries with a very inconſiderable Force; ſuch a one, ſurely, as will be far from being able to puſh theſe Fluids through the ſerous, lymphatic, and, for any Thing we know, many more inferior Orders of Veſſels.

But, to ſet this Matter in a ſtill ſtronger Light, we ſhall, upon the Principles above laid down, endeavour to inveſtigate the Force of the Heart at the Origin of the Nerves.

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* Statical Eſſays, Vol. II. p. 47, 68.
† Medical Eſſays, Vol. II. Art. VII & V.

Lewenhoeck tells us, that he discovered Vessels, in the cortical Part of the Brain, which could not admit a Globule of Blood whose Diameter was $\frac{1}{12800}$ Part of an Inch*; and he observed the Fibres of its medullary Substance to be either quadrangular or hexangular: Whence he concludes, that they must be composed of smaller Fibrillæ, whose extreme Minuteness made it impossible for him to discover any Thing of their Figure. Nor does he think they can ever be seen distinctly by human Eyes†.

Dr. Porterfield has, indeed, from an Experiment of Dr. Hook, computed the Diameter of a single nervous Fibre to be $\frac{1}{12000}$ Part of an Inch‖. But as the best Microscopes have never been able to discover any Cavities in the Nerves, it is certain, that, if they are hollow Tubes at all, the Diameters of their Cavities must be a great deal less than this, and, perhaps, fall short of $\frac{1}{200000}$ Part of an Inch. For a Microscope, which magnifies the Diameter of an Object 800 Times, would, upon this Supposition, make the Cavities of the Nerves appear equal to a Point whose Diameter is $\frac{1}{250}$ Part of an Inch, which is an Object that may be discovered by a good Eye.

Lewenhoeck, it is true, towards the End of his Days, and when more than Eighty Years old, pretended, more than once, to have seen Cavities in the Nerves very distinctly: But it happens unluckily, for this Discovery, that no Body has been able to confirm it since his Death. Nor could he, when alive, though he saw these Cavities himself, shew them to any one else; as appears, from the following Passage in his XXXIId Epistle. "Id "unum in hoc negotio male me habet, quod

* De Cerebro, p. 35. † Epist. XXXIV. ‖ Medical Essays, Vol. IV.

"Cavi-

" Cavitates illas nemini poſſum conſpicuas exhi-
" bere; nam ſimulac illas Oculis meis exami-
" nandas admoveo, illico & minuto citius per ex-
" ſiccationem concedunt." But if the ultimate Fibres of the Medulla Oblongata were ſo fine, that he could diſcover nothing of their Shape or Figure, as he himſelf confeſſes; it will not be thought probable, that he could diſcover the Cavities of the Nerves, which ſeem to be a Production of theſe, and, at leaſt, equally ſubtil with them.

But leſt any one, unaccuſtomed to Speculations of this Kind, ſhould think the Motion of a Fluid through ſuch vaſtly ſubtil Veſſels as the Nerves, almoſt impoſſible; let him reflect a little on the infinite Diviſibility of Matter, and, particularly, on the extreme Ductility of Gold, which may be drawn over Silver ſo as the Thickneſs of the Skin of Gold (in which, however, the beſt Microſcope cannot diſcover the ſmalleſt Pore) ſhall not amount to $\frac{1}{1200000}$ Part of an Inch*; i. e. a ſixtieth Part of what we ſuppoſe the Diameter of the Cavity of a Nerve may be. So that the Particles of ſuch a Leaf of Gold, ſwimming in a Fluid, might paſs more eaſily through the Nerves, than a ſingle Globule of red Blood does through its capillary Artery.

Farther; a Bubble of ſoaped Water, when managed after Sir ISAAC NEWTON's Method, exhibits, juſt before it breaks, a black Spot upon its ſuperior Part; the Thickneſs of which, according to his Theory of Light and Colours, ſcarcely exceeds $\frac{1}{3000000}$ Part of an Inch. Hence we ſee, that a Fluid, compoſed of Soap and Water, i. e. of alcaline Salt, Lime, Oil, and Water, may be divided, by human Art, into Parts whoſe Dia-

* Memoires de l'Acad. des Sciences, ann. 1713.

meter is fifteen Times less than that which we have assigned to the Nerves; and, consequently, that such a compound Fluid might easily pass through their Cavities.

Let us, then, suppose the Diameter of the Cavity of a Nerve to amount to $\frac{1}{200000}$ Part of an Inch, and the Area of its transverse Section will be 0.00000000000196; which, multiplied into 90 (the Height of a Column of Blood whose Weight is supposed equal to the pressing Force of the left Ventricle of the Heart), gives 0.000000001176 Parts of a cubic Inch of Blood, or $\frac{1}{2140000}$ Part of a Grain; which would be equal to the Moment of the animal Spirits, at the Origin of the Nerves, arising from the impulsive Force of the Heart, if there were no Loss of Motion from Friction, and if the Area of the transverse Section of the Aorta was equal to the Areas of the transverse Sections of all the extreme capillary Vessels in which the numerous Branches and Ramifications, derived from the Aorta, at last terminate. But, if we consider how greatly the latter must exceed the former, and, upon Dr. KEILL's Principles, enter into a Computation of the Effect which this must have upon the Motion of the nervous Fluid; we shall find, that its Velocity will be to that of the Blood in the Aorta, nearly, as 1 to 20000; and, consequently, the Moment of the nervous Fluid, arising from the protrusive Force of the Heart, will be only equal to $\frac{1}{2140000} \times \frac{1}{400000000} = \frac{1}{856000000000000}$.

If we imagine a Sphere to be composed of the Particles of the nervous Fluid, whose Diameter is equal to the Diameter which we have assigned to the Cavity of a Nerve; then, taking its specific Gravity to be the same with that of Water, its Weight will amount to $\frac{1}{45228780325014}$ Part of a Grain; i. e. near 19 Times more than the Force

with

with which it is pushed forward by the Contraction of the left Ventricle of the Heart; even upon the Supposition that it had met with no Resistance from Friction in its Passage through the small Vessels of the Brain. Hence the Moment of a small Sphere of animal Spirits, in a Nerve, is 38 Times less, in Proportion to its Weight, than the moving Force of a Globule of red Blood in its capillary Artery; and the Difference of their Forces will be still greater, in Proportion to the Resistance which each has to overcome; since the Resistance to the Motion of a Fluid, from Friction, must be, cæteris paribus, as much greater in the Nerves than in the red capillary Arteries, as the Diameter of the latter exceeds that of the former.

But farther; since the longer any capillary Vessel is, the more will the Motion of a Fluid be retarded, and, consequently, its Force be diminished in it. It is easy to see, that in the Nerves, whose Cavities are so inconceivably small, but whose Length is generally very considerable; the Force of the Heart, which we have shewn to be surprisingly little, must be altogether unable to overcome the Friction; nay, even the mutual Attraction of Cohesion between them and their Fluid, and, consequently, be of itself, and when unassisted by any other Power, wholly insufficient to propel the animal Spirits to all the different Parts of the Body; and this even upon a Supposition that the Nerves were continued directly from the extremely minute capillary Arteries. But if we consider how much the Force of the Blood must be broken in passing through the infinitely convoluted and amazingly fine Vessels of the cortical Part of the Brain, together with the Follicles in which these are imagined (by some) to terminate; what we have been contending for, will appear still more evident.

Laſtly, The above Reaſoning receives additional Weight from thoſe Experiments which ſhew that the Brain may be nouriſhed, perform its Office, and afford a ſufficient Supply of Spirits for carrying on all the vital and animal Functions, altho' the Blood is puſhed by the Heart into its Veſſels with a great deal leſs Force than uſual.

Thus the learned Dr. Van Swieten informs us, That he tied both the carotid Arteries of a Dog, without any obſervable Inconvenience to him: On the contrary, he continued twelve Days healthful and lively. After which Time, he opened his Skull, but could diſcover nothing preternatural in the Brain*.

Now as in this Dog the Brain could only be ſupplied by the vertebral Arteries which inoſculate with the Carotids; the Velocity, and, conſequently, the Moment of the Blood, muſt, at the ſame Time that it was conſiderably leſſened in the Ramifications of the former, have been ſo remarkably diminiſhed in thoſe of the latter, by reaſon of the Smalneſs of the Branches with which they communicate, compared with the Trunks of the Carotids, as to ſhew, beyond Doubt, that the Secretion of the nervous Fluid, and its Derivation to the ſeveral Parts of the Body, do not depend ſo much upon the Force of the Heart as has been generally imagined; but muſt be, in a great meaſure, owing to ſome other Cauſe.

Having ſhewn how inconſiderable the Moment of the Fluids, ariſing from the projectile Force of the Heart, muſt be, in the inferior Orders of Veſſels, and particularly at the Origin of the Nerves; we come now to take a View, ſomewhat different, of the Matter, and to compare the real Force of

* Comment. in Boerh. Aphor. Vol. I. p. 266.

the

the left Ventricle of the Heart with the Obſtacles it has to overcome, upon a Suppoſition that, at each Syſtole, it puſhes forward the whole circulating Fluids in all the Arteries and Veins of the Body.

BORELLI computed the Reſiſtance which the Blood meets with, in circulating through all the Veſſels of the human Body, to be equal to 180000 Pounds Weight*. But though this be over-rating the Matter very much; yet, after all the Abatements that can be reaſonably allowed, there will remain a Reſiſtance by much too great to be overcome by the Force alone of the left Ventricle of the Heart; a Force which cannot, in Man, amount to 60 Pounds Weight †; as far as can be gathered from the lateſt and beſt Experiments which have been made on other Animals, in order to determine the preſſing Power of the Heart. Yet, inconſiderable as this Force is, it is not to be regarded as that communicated to the Blood in the Aorta, but only as the Preſſure or Weight ſuſtained by the whole internal Surface of the left Ventricle of the Heart, juſt when it begins to contract; and the Force with which the Blood is impelled into the Aorta, will (ſince Fluids preſs equally unde quaque) bear no greater Proportion to this than the Area of the Orifice of the Aorta does to the whole internal Surface of the left Ventricle of the Heart; i. e. ſuppoſing the Area of the Orifice of the Aorta equal to one Fifth of a ſquare Inch: and the internal Surface of the left Ventricle (equal to 15 ſquare Inches ‖) as 1 to 30: And therefore

* De Motu Animal. Part. II. Prop. 73.
† Dr. HALES makes it only 51 Pounds. Statical Eſſays, Vol. II. p. 40.
‖ HALES loc. citat.

the Force with which the Blood is puſhed into the Aorta muſt fall ſhort of one 30th Part of 60 Pounds Weight. Hence a Reſiſtance in the Aorta, equal to two Pounds, will require a Force of above 60 Pounds, excited by the whole internal Surface of the left Ventricle of the Heart to overcome it: From which it follows, either that the Reſiſtance to the Motion of the Blood in the Aorta, and all its Branches and Ramifications muſt be leſs than two Pounds, which I believe no Body will affirm; or elſe, that the protruſive Force of the left Ventricle of the Heart, alone, is unable to drive the Blood through all the Veſſels; and, conſequently, inſufficient, without the Aſſiſtance of ſome other Power, to carry on the Circulation.

If any one ſhould, on this Occaſion, have Recourſe, with the learned BORELLI, to the Vis Percuſſionis, we need only obſerve, that the Force of the Heart is, evidently, not a percuſſive, but a preſſing one: So that, altho' the leaſt percuſſive Force may be greater than any finite quieſcent Reſiſtance; yet this will not hold true of a preſſing Force; which, in order to have any ſenſible Effect, muſt be greater than the Reſiſtance it has to overcome. To ſay otherwiſe, is to affirm, that, with the preſſing Force of one's Hand, the greateſt Mountain might be moved out of its Place.

Nor is Dr. KEILL's Account of this Matter more ſatisfactory; viz. that, the Blood being once put in Motion, a very ſmall Force, in the Heart, may be ſufficient to keep it always in this State: For this Force muſt be equal to the Loſs of Motion ſuſtained by the Blood, in every Circulation, and, conſequently, to the Reſiſtance which this Fluid meets with in its Paſſage through all the Veſſels of the human Body; a Reſiſtance too great to be balanced by the few Ounces to which the

Doctor

Doctor has reduced the Force of the left Ventricle of the Heart*.

But that the Foundation, upon which Dr. KEILL proceeds, is falſe; and that the Heart can really communicate a new Motion to the Blood, when the old one is, in a great meaſure, loſt; and after all the Fluids have been, for ſome Time, almoſt entirely at a Stand; is evident, from the Recovery of People who have lain, for ſome Time, in a Syncope; and from the Revival of ſleeping Animals, which are, in Appearance, dead all the Winter-ſeaſon.

But farther; ſince the Blood, when it returns to the right Ventricle of the Heart, has ſcarce one Tenth of the Force with which it was thrown into the Aorta†; it is plain, that it acquires, every Circulation, nine Tenths of its Force in paſſing through the Heart and Lungs.

Thus much being ſaid to ſhew that the Force of the Heart is, of itſelf, not ſufficient to carry on the Circulation; we ſhall next briefly conſider the alternate Contraction of the Aorta and its Branches, which has been juſtly reckoned among the chief Cauſes of the Motion of the Blood.

The Blood thrown out, at every Syſtole, by the left Ventricle of the Heart, is not inſtantly tranſmitted through the capillary Arteries into their correſponding Veins; but the greateſt Part of it is accumulated in the now dilated Arteries, and is, during their ſucceeding Contraction, conveyed on through the ſmaller Veſſels. This Contraction, however, of the Arteries, may, perhaps, be conſidered rather as a Continuation of the Heart's Force, than as any new Power impreſſed on, or communicated to, the Blood; ſince it does not ap-

* Tentam. Med. Phyſ. 3. de vi Cordis.
† HALES's Statical Eſſays, Vol. II.

pear,

pear, that the Arteries contract with a greater Force than that by which they were dilated. But, whatever may be the Force with which the Aorta and its Branches reſtore themſelves, we know certainly, that it is leſs than the ſyſtolic Power of the left Ventricle of the Heart; becauſe the Blood is obſerved always to be projected to a greater Diſtance from a cut Artery, during its Diaſtole, than in the Time of its Syſtole. Whence it follows, that, if the Force of the Heart is inſufficient to account for the Motion of the Fluids through the inferior Orders of Veſſels, the alternate Contraction of the muſcular Coat of the Aorta and its Branches muſt be ſo likewiſe.

It is, however, to be obſerved, that the ſanguiferous Arteries, whoſe numerous Branches are diſperſed every where through the Body, muſt not only, by their alternate Contraction, contribute to puſh forward their contained Fluids; but alſo, by their Dilatation, ſo compreſs the inferior Orders of Veſſels, as ſomewhat to promote the Motion of the Fluids in them*.

I ſhall only add, on this Head, that, as the alternate Contraction of the Arteries depends entirely upon their preceding Dilatation by the Heart; ſo, in the ſerous and inferior Orders of arterial Veſſels, to which the projectile Force of the Heart ſeems not to reach, there is no ſuch alternate Dilatation and Contraction to be obſerved†.

With Reſpect to Gravity, which ſome have reckoned among the Cauſes promoting the Circulation, it is ſufficient to obſerve, that, in a horizontal Poſition of the Body, it can have no Effect; and, in an erect one, it muſt retard the Return of the Blood, by the Vena Cava Inferior, as much as

* See Medical Eſſays, Vol. V. p. 2. Edit. III. p. 39.
† LEWENHOECK. Epiſt. LXV. p. 167.

it

it promotes its Motion downwards in the Aorta and its Branches.

There is ſcarcely any Thing that will ſooner or more naturally ſtrike the Mind of one who enquires into the Cauſes of the Motion of the Fluids, in the very minute Veſſels of Animals, as well as Vegetables, than that ſurpriſing Power of attracting Liquors which capillary Tubes are endowed with. But although the attractive Power of ſuch Tubes may aſſiſt us in accounting for the Imbibition of Fluids by the Veſſels commonly called Abſorbents, as we ſhall afterwards have Occaſion to ſhew; yet it muſt appear evident, to every one acquainted with the Phænomena of theſe Tubes, that this Attraction can be of no Uſe in promoting the Circulation of the Blood in the capillary Arteries and Veins, ſince theſe Veſſels are always full; or, if they were not, the Fluids would be determined by it, equally backward towards the larger Arteries, as forward to the Veins.

That the vibratory Motion of the ſmall Veſſels of Animals is the principal Cauſe promoting the Circulation of the Fluids. From the ſame Author.

Having ſhewn the Inſufficiency of the Powers, already mentioned, to account for the Circulation of the Fluids in the very ſmall Veſſels of Animals; we ſhall now proceed to explain what we imagine to be the principal Cauſe of this Circulation.

Although, as has been obſerved above, the regular alternate Pulſation of the Arteries does not extend beyond the Capillaries of the firſt Order, except, perhaps, in Places very near the Heart; yet we are not to conſider the ſerous, lymphatic, and other ſtill ſmaller Veſſels, as inactive Canals, no

no ways contributing to promote the Circulation of their different Fluids: On the contrary, it ſeems highly probable, that theſe Veſſels are continually agitated with very ſmall alternate Contractions, to which the Circulation in them is, in a great meaſure, owing.

Many phyſiological Writers have ſuppoſed an oſcillatory Motion in the ſmall Veſſels of Animals, but few have ſaid any Thing ſatisfactory concerning the Cauſe of this Motion.

Baglivi ſuppoſed the membranous Parts of the Body to derive their Oſcillations from the Dura Mater, and the vaſcular Syſtem and fleſhy Fibres theirs from the Head: But as it is known, beyond doubt, that the Dura Mater has no other Motion than what ariſes from the Pulſation of its own Veſſels, or thoſe of the Brain; and as the alternate Contractions of the Arteries depending upon their preceding Dilatation by the Blood thrown out by the Heart, has no Place in the ſerous, lymphatic, and inferior Orders of Veſſels; the vibratory Motion of theſe Canals muſt be deduced from ſome other Cauſe.

Many Experiments and Obſervations ſhew, that the muſcular Fibres of Animals are ſo framed, as to be readily excited to Contraction by a Stimulus. The ſmall Veſſels, therefore, which are endowed with a muſcular Tunic, as well as the larger ones, muſt neceſſarily be agitated with alternate Contractions, as often as they are acted upon by any Thing capable of gently irritating them; but ſuch are the Blood and finer Fluids derived from it, which, while they ſlowly glide through the ſmall Veſſels, ſtimulate their internal Surface, ſo as to excite them to gentle, but continually repeated Contractions.

Some of the greateſt Philoſophers and Phyſicians, of antient as well as later Times, have ima-

imagined the Blood to be a very active Fluid, endowed with uncommon Qualities, and, as it were, the Fountain and Source of Life in Animals: Nor do they seem to have been led into this Opinion so much from any favourite Theory, as from Experiments and Observations made on living and dying Animals.

But, without entering into, much less defending, the peculiar Notions of these Authors concerning the Blood, we shall only say, that this Fluid is extremely well fitted to act, as a gentle Stimulus, upon the sensible Fibres of Animals, whether we consider its Composition, Heat, or intestinal Motions. For, while the saline and other acrid Particles in the Blood render it fit to irritate the tender Vessels, its Heat and intestinal Motion keep all its Parts in a perpetually vibrating State, which must increase their stimulating Power.

Agreeably to this, we find, that, in many Insects, and some larger Animals, the Circulation becomes more languid, as the Weather grows colder; and, in the Winter Season, is altogether at a Stand; till, by the Heat of the returning Spring, the Particles of the Fluids begin to be briskly agitated, and, consequently, the Solids stimulated to Contraction.

Dr. Harvey has long since remarked, that the Hearts of several Shell Fishes are only seen to beat in warm Weather; and the curious Observations of De Reaumur have shewn us, that the Lives of Insects may be lengthened or shortened, and made more or less active, by exposing them to different Degrees of Heat and Cold.

Thus much being said to shew that the Blood is well fitted to act as a Stimulus, we shall offer some farther Considerations to prove, that the small Vessels are, by its Influence, really excited to alternate Contractions.

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And, 1. We are led to conclude this from what we obſerve in the larger Canals and Veſſels of Animals. Thus the ſeveral Portions of the inteſtinal Tube are ſollicited to alternate Contractions by the Aliment, Air, and Bile, ſtretching their Tunics, and ſtimulating their internal Surfaces: And as we imagine an alternate Motion, in the ſmall Veſſels, neceſſary to promote the Circulation of the Fluids in them; ſo we know certainly, that the periſtaltic Motion of the Inteſtines is the principal Cauſe which conveys the digeſted Aliment down towards the Anus.

Not only the Auricles and Ventricles of the Heart, but alſo the Trunks of the Venæ Cavæ adjoining to the right Sinus Venoſus, are continually agitated with alternate Contractions. The Trunks of the Venæ Cavæ preſerve this Motion in Animals, newly dead, a conſiderable Time after the Pulſation of the Heart has ceaſed; but no ſooner is the Blood contained in theſe Veſſels evacuated, and all new Supplies intercepted by Ligatures, than their Sides collapſe, and remain without the ſmalleſt Motion. Whence we are led to conclude, that the alternate Contractions of theſe Veins are, like thoſe of the Heart, owing to the Blood acting on them as a Stimulus.

It is generally allowed, by Phyſiologiſts, that the Syſtole of the larger ſanguiferous Arteries, in which a remarkable Pulſation obtains, is owing not only to their Elaſticity, whereby they endeavour ſimply to recover themſelves; but partly, alſo, to a proper muſcular Contraction of their tendineo-carnous Tunic: And, as this is excited by the Blood puſhed into them by the Heart, which, at the ſame Time that it diſtracts their Fibres, gently irritates their internal Surface; it ſeems highly reaſonable to allow, that the ſmaller Veſſels, endowed at leaſt with equal Senſibility, muſt be

be excited to feeble, but continually repeated Contractions, by the gentle Stimulus of their circulating Fluids.

Farther: As there are some of the more imperfect Animals which have no Heart, the Circulation in them must be owing to the contractile Power of the Vessels themselves, excited to Action by the Stimulus of the Fluids: And that the Vessels of those Animals, which, in a natural State, have a Heart, are endowed with a similar Power, seems proved, by Examples of Monsters wanting a Heart, or any Thing analogous to it; in whom the Fluids must have circulated chiefly by the Power of the Vessels.

A great Variety of Facts might be produced, which clearly demonstrate an alternate contractile Power in the small Vessels of Animals; and that this is exerted, more or less, according to the Degree of Irritation affecting them.

Thus the Steams of warm Spirit of Wine, received into the Eye, not only cause a greater Flow of Tears from their Vessels; but, in a few Seconds, produce an artificial Inflammation in them; that is, they make the Globules of red Blood enter the serous or lymphatic Vessels of the Conjunctiva. Now, as this additional Moment of the Blood, whereby it is enabled to dilate these Vessels, cannot proceed from the Heart or larger Arteries, since their Force is not, nor can be altered in the present Case; it must be owing to the extraordinary oscillatory Motion excited, in the Vessels of the Eye, by the Steams of the Spirit of Wine.

I presume it will not be alledged, that the Vapour of Spirit of Wine raises an Inflammation in the Eye, by constringing its Vessels, so as to occasion an Obstruction in them; and that this Obstruction afterwards produces the Inflammation, by lessening the Number of Vessels thro' which

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the Blood passes; and, consequently, increasing its Force upon the obstructed ones. For, not to insist on what might be easily proved, that no Obstruction can ever produce an Inflammation except so far as it gives Rise to an unusual Irritation; the Spirit of Wine should, by constringing the serous and lymphatic Vessels of the Conjunctiva, enable them to sustain this additional Force.

But farther: Why does tepid Milk and Water, or a Poultice of Bread and Milk, lessen an Inflammation of the Eye, while acrid, astringent, and spirituous Liquors, increase it? According to the Doctrine of Inflammations from mere Obstructions, together with an increased Force of the Heart and larger Arteries, one would think, that the former should, by relaxing the small Vessels, expose them to be still more and more dilated by the increased Force of the Blood, and so increase the Inflammation; while the latter should, by constringing those Vessels, enable them not only to resist the Blood impelled by the Heart, but also expel the obstructing red Globules. But the Truth of the Matter is, that the tepid Milk and Water, and Poultice, by relaxing the Vessels, lessen or remove the Irritation and Sense of Pain, which, by raising uncommon Contractions in the small Vessels, was the Cause of the Inflammation; while acrid, astringent, and spirituous Applications, tho' they tend to constringe the Vessels, yet, by increasing their vibratory Contractions, greatly augment the Motion of the Blood in them; and therefore must necessarily increase the Inflammation.

The Heat, Redness, and Inflammation, brought on the Skin by Blisters and Sinapisms, are not owing to any Increase of the Heart's Force, or of the Moment of the Blood in the larger Vessels, though this is often an Effect of their Application;

tion; but merely to the Action of thoſe irritating Subſtances on the cutaneous Veſſels, whereby the Motion of the Fluids in them is greatly augmented.

The ſudden Redneſs and glowing Warmth of the Face, which, in the Fair Sex eſpecially, accompanies a Conſciouſneſs of Shame, and is commonly diſtinguiſhed by the Name of Bluſhing, can only be ſatisfactorily accounted for from an increaſed oſcillatory Motion of the ſmall Veſſels of the Face.

The extraordinary Flow of Saliva, which happens to hungry Perſons from the Sight, or even the Remembrance, of grateful Food, and the profuſe Secretion of Urine which hyſterical People are frequently ſubject to, cannot be explained without having Recourſe to an increaſed Motion ſuddenly excited in the ſmall Veſſels of the ſalivary Glands and Kidneys; and clearly ſhew, that the Quantity of Saliva and Urine, ſeparated by theſe Organs, does not depend ſo much upon the Force with which the Blood is determined into their Veſſels by the Heart, as upon the greater or leſſer vibratory Motions of the ſecerning Veſſels themſelves. And, in the ſame Manner, is it not reaſonable to believe, that the Motion of the Fluids in the ſmalleſt Veſſels every-where through the Body, is as much, perhaps more, owing to their gentle alternate Contractions, than to the Force of the Heart and larger Arteries?

The Secretion of Tears, which is very little affected by the different Forces with which the Blood is impelled by the Heart, is immediately increaſed, in a very great Degree, by acrid Applications to the Eyes, or certain Paſſions of the Mind.

In the firſt Caſe, the greater Secretion is owing to the acrid Matter; which, by its Irritation, raiſes

an uncommon vibratory Motion in the lachrymal Veſſels. Nor can it be, with Reaſon, objected here, that acrid Things, applied to the Eyes, or received into the Mouth, occaſion a greater Flow of Tears, or Saliva, not by raiſing any ſtronger oſcillatory Motion in the Veſſels of the lachrymal and ſalivary Glands, but merely by conſtringing their excretory Ducts, and ſo ſqueezing out the Liquors contained in them; ſince the Quantity of Tears and Saliva, diſcharged in ſuch Caſes, ſhews, that not only the Excretion, but Secretion, in theſe Glands, is greatly increaſed. And if an Irritation of the Pelvis, Kidney, or Ureter, from a Stone lodged there, often occaſions an uneaſy Senſation in the Extremity of the Urethra; is it not reaſonable to think, that, upon the Application of ſtimulating Things to the Orifices of the lachrymal and ſalivary Ducts, theſe will not be affected alone; but the Irritation will, in ſome Degree, be communicated to the ſmall ſecerning Veſſels of their reſpective Glands, ſo as to excite in them ſtronger and more frequently repeated Contractions, and, conſequently, increaſe their Secretion.

The Flow of Tears, which accompanies certain Affections of the Mind, is, like the greater Secretion of Saliva from the Sight of grateful Food, and the Heat and Redneſs of the Face from a Conſciouſneſs of Shame, owing to an unuſual vibratory Motion excited in the lachrymal Veſſels in Conſequence of theſe Affections, and not to any Compreſſion which the lachrymal Gland may ſuffer from ſome of the adjacent Muſcles which are then brought into Contraction: For no Degree of alternate Compreſſion, applied to this Gland, remarkably increaſes the Secretion of the Tears, unleſs its Veſſels, or thoſe of the Eye, are thereby irritated.

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We have already ſeen, that an increaſed oſcillatory Motion, in the ſmall Veſſels, occaſions a quicker Flow of Liquors through them: And the following ſhort Hiſtory will ſhew, that, when this Motion is much diminiſhed, or wholly ſuſpended, theſe Veſſels collapſe, and the Circulation in them either becomes very languid, or wholly ceaſes.

A Boy, between four and five Years of Age, was, one Saturday Afternoon, ſuddenly ſeized with an Apoplexy, or Abolition of Senſe and voluntary Motion: On Sunday Morning, at Nine o'Clock, when I firſt ſaw him, his Pulſe was full and quick, and his Eyes had ſomewhat of a glazed Look; but, in the Evening, this was more remarkable: On Monday, a little before Noon, he was ſtill alive, but his Breathing very laborious, and his Pulſe ſmall and quick: At this Time his Eyes were more ſhrivelled than they are uſed to be in thoſe who have been ſeveral Hours dead.

This glazed Appearance of the Eyes could not be owing to the Diminution of the Heart's Force, ſince the Pulſe was full and ſtrong for twenty-four Hours after the Diſeaſe came on: Nor can the Failure of the Pulſe, afterwards, account for the Shrivelling more than is uſual in Perſons newly dead. But if the Circulation of the Fluids in the ſmall Veſſels be chiefly owing to a vibratory Motion in them; and if this muſt ceaſe, when the Influence of the Nerves is intercepted; in this Boy, whoſe Brain, eſpecially its anterior Part, was ſo remarkably obſtructed, the Motion of the Fluids in the very ſmall Veſſels of the Cornea, and the Secretion of the aqueous Humour, muſt have been greatly diminiſhed; and hence the Dimneſs and Shrivelling of the Eyes.

The withering of a Member that is palſied, or deprived of the nervous Power, is to be accounted for in the ſame Manner; and is a Proof that the

Circulation of the Fluids through the inferior Orders of Veſſels, is not ſo much owing to the Force of the Heart, as to the Action of theſe Veſſels themſelves.

This withering of a palſied Member has made ſome imagine, that Nutrition is performed by the Nerves: But the Phænomenon, we ſee, is eaſily accounted for, without this Suppoſition; and there are good Reaſons to think, that the Nerves are ſolely ſubſervient to Motion and Senſation.

Laſtly, Although the alternate Contractions of the ſmaller Veſſels, which we have been contending for, are not remarkable enough to be diſcerned in moſt Animals; yet they may be clearly ſeen in the Legs of a Bug; in the ſmall Veſſels of which, an extraordinary Vibration is diſcovered, by the Microſcope.

The Objection againſt the Reality of a vibratory Motion in the ſmall Veſſels of Animals, becauſe the Microſcope ſhews no ſuch Thing in moſt Animals, is of no great Weight, ſince it cannot be doubted, that the Particles of all Bodies, eſpecially Fluids, are affected, by Heat, by perpetual oſcillatory Motions; and yet, unleſs the Heat be great, the Eye, even aſſiſted by the beſt Microſcopes, cannot diſcern any ſuch Thing.

Farther: Since the Microſcope only ſhews the Circulation of the Fluids in the red capillary Arteries, but not in the ſerous, lymphatic, and many inferior Orders of Veſſels; can it be expected, that any alternate vibratory Motion ſhould be diſcovered in theſe Veſſels? Or is it reaſonable to deny an alternate Motion to all Veſſels, or Particles of Matter, which are too ſmall to fall under the Notice of our Senſes?

Although the Branches of the Vine were tranſparent, ſo that the Motion of the Sap in its Veſſels could be ſeen, by the Help of a good Microſcope;

ſcope; yet, it is very probable, we ſhould not be able to diſcover any vibratory Motion in them: And yet the Force of the Sap, in the bleeding Seaſon, ſhews, that, beſides Attraction, there muſt be a real propelling Power exerciſed by the Veſſels of the Vine.

If the Diameter of the Aorta, in its Diaſtole, does not exceed its Diameter when contracted above one Fifth of a Line, i. e. one Fiftieth of its Diameter; and if the Change of Diameter, which happens, in the red capillary Arteries and inferior Orders of Veſſels, from their vibratory Contractions, be three Times leſs, in Proportion to the Magnitude of theſe Veſſels, than the Difference of Diameter in the Aorta, ariſing from its alternate Diaſtole and Syſtole; then the Difference between the greateſt and leaſt Diameter of a capillary Artery, capable of receiving only one Globule of red Blood, when moſt dilated or contracted, will be equal to a Hundred and fiftieth Part of its Diameter: i. e. Suppoſing its Diameter a two Thouſandth Part of an Inch, equal to a three Hundred thouſandth Part of an Inch; and the Space deſcribed by each Side of ſuch an Artery, when it performs one of its ſmall vibratory Contractions, will be only equal to a ſix Hundred thouſandth Part of an Inch; which is greatly too ſmall to be diſcerned by the beſt Microſcope.

Having thus endeavoured, by a Variety of Arguments, to ſhew, that the ſmall Veſſels of Animals are, through the gentle Stimulus of the Fluids, continually agitated with alternate Contractions; we ſhall now briefly point out their Uſe in carrying on the Circulation. And it muſt appear evident, to every one, that the inferior Orders of Veſſels will not only not retard the Motion of the Fluids, but greatly promote it; ſince every Ringlet of them will, like a little Heart, by its alter-

nate Contractions, push on its contained Fluids. Nor ought these Contractions, however weak and imperceptible, to be thought unable to produce this Effect; since the Motion of the Fluids, in the very small Vessels, is far from being rapid, and just such as might be expected to arise from this Cause.

Dr. Hales has observed, that, in a capillary red Artery in one of the Muscles of the Abdomen of a Frog, the Blood moved only an Inch in a Minute and a Half: And it is probable, that, in the finest secretory Vessels of the Brain, the Fluids may not move above a Parisian Line, or an Inch and a Half, in a Minute; i. e. not twice as fast as the Minute Hand of a small-sized Watch.

If it be objected, that, as the capillary Arteries and Veins are destitute of Valves, their alternate Contractions must push the Fluids equally back towards the Heart, as onwards to the larger Veins: It may be sufficient to answer, That the Resistance, arising from the semi-lunar Valves of the Aorta, and from the Force of the Heart and larger Arteries, à Tergo, being greater than that which opposes the Transmission of the Fluids into the larger Veins, the Fluids acted upon by the small vibrating Vessels, must necessarily be determined towards the latter.

But farther: Why may not the alternate Contractions of the small Vessels, like the peristaltic Motion of the Intestines, proceed in such a Manner, as to impel their Fluids more remarkably onwards to the Veins, than backwards to the larger Arteries?

Upon the Whole, as we conceive the Motion of the Blood in the larger Vessels, and even Capillaries of the first Order, to be owing to the alternate Systole of the Heart and Arteries; so, in the serous, lymphatic, and still smaller Vessels, where this Force either reaches not at all, or is greatly

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diminiſhed, the Circulation ſeems to be carried on chiefly by the vibratory Motions of theſe Veſſels themſelves: And the finer Fluids being, in this Manner, tranſmitted to the larger Veins, the Pulſation of neighbouring Arteries, Action of voluntary Muſcles, and alternate Compreſſion made upon all the Contents of the Abdomen and Thorax, by the Motion of Reſpiration, will promote their Return to the Heart along with the red Blood in the Venæ Cavæ.

What we have ſaid of the Circulation of the Fluids in general, we would have underſtood alſo of their Motion in the ſecretory Ducts of the ſeveral Glands. In thoſe Glands whoſe Veſſels are moſt patulous, the Secretion may be partly, and indeed in a good meaſure, carried on by the Force of the Heart and larger Arteries; a Proof of which ſeems to be, the bloody Urine paſſed by ſuch as have weak Kidneys, after violent Exerciſe: But in other Glands whoſe Structure is finer, and, particularly, in the Brain, the Motion of the Fluids, in the ſecretory and excretory Veſſels, ſeems to be much leſs owing to the Force of the arterial à Tergo, than to the gentle vibratory Contractions of the Veſſels themſelves.

With Regard to the Nerves, which are generally conſidered as the excretory Ducts of the Brain; it is probable, that the Derivation of their Fluid to the various Parts of the Body is not only owing to a gentle oſcillatory Motion in them, and their ſurrounding Membranes, but alſo, in ſome Degree, to their Attraction as capillary Tubes: For no ſooner can there be a Waſte of this Fluid at the Extremity of any Nerve, whether this happens from Exhalation, alternate Compreſſion of the neighbouring Parts, or any other Cauſe than by its attractive Power, it will be filled again. In the other Glands, however, whoſe excretory Ducts,

by their Union, ſoon form pretty large Canals, no ſuch Attraction will have Place.

From what has been ſaid, it may appear, that we are not to conſider the Force of the Heart, and Contraction of the larger Arteries, as the ſole Cauſes of the Circulation of the Fluids in Animals. The whole vaſcular Syſtem is endowed with a moving Power, which is conſtantly excited to Action by the Stimulus of the circulating Fluids; ſo that, while the ſmall Veſſels, by means of Frictions, deſtroy, in Part, the Moment of the Juices; they, at the ſame Time, communicate, by their gentle vibratory Contractions, a new Impulſe to them. Every Part, therefore, of the vaſcular Syſtem, as well as the Heart and larger Arteries, nay, every Ringlet even of the ſmalleſt Veſſel, is to be conceived as promoting the Circulation of the Fluids, that great Work, upon which the Life of the Whole depends; and, in carrying on which, almoſt every Part of the Body is active.

If the Motion of the Fluids, in the inferior Order of Veſſels, be not ſo much owing to the Force of the Heart and larger Arteries, as to the gentle alternate Contractions of thoſe Veſſels themſelves; we may eaſily ſee, why Frictions, warm, penetrating, and ſtimulating Fomentations, Cataplaſms, &c. are often more ſucceſsful than internal Medicines, in removing Obſtructions in the ſerous, lymphatic, and other ſmall Veſſels; ſince they not only contribute to attenuate the obſtructing Matter, but greatly increaſe the oſcillatory Motion of theſe Veſſels.

For the ſame Reaſon it is, that the warm mineral Waters, pumped with a conſiderable Force upon a Part affected with the Rheumatiſm, or Sciatica, have effected a Cure, after other Remedies have been uſed in vain.

Warm

Warm Spirit of Wine, either alone, or mixed with other Things, often proves a good Diobſtruent; yet I have known ſome People, who were afraid to uſe it, with this Intention, becauſe it is known to coagulate the Serum of the Blood: But their Fears were without Foundation. For the Quantity of Spirit of Wine which enters, by the Pores of the Skin, is ſo ſmall, as to be in no Danger of producing any Coagulation. Beſides, as it is taken in by the abſorbent Veins, it muſt go to the Heart, and be mixed with the Maſs of Blood, before it can come at the obſtructed Veſſels. But, altho' little is to be expected from the reſolving, and nothing is to be dreaded from the coagulating Power of the Spirit of Wine; yet it proves, in many Caſes, a good Deobſtruent, by raiſing an uncommon vibratory Motion and Heat in the Veſſels of the Part to which it is applied.

If the Circulation in the ſmall Veſſels be, in a great meaſure, owing to their oſcillatory Motion excited by the Stimulus of the circulating Fluids; it will follow, that when theſe Veſſels, in any Part of the Body, are affected with an extraordinary Irritation, they muſt neceſſarily be agitated with much ſtronger and more frequently repeated Contractions than uſual; whence the Force of the Blood in them will be greatly increaſed: In Conſequence of which, the Part will be inflated, and Globules of red Blood will be forced into the ſerous Veſſels, i. e. an Inflammation will be produced; and this muſt happen, whether the Force of the Blood be, or be not, increaſed in the other Veſſels of the Body.

An Inflammation, therefore, is not owing to an increaſed Force of the Heart and larger Arteries conſequent upon an Obſtruction, as ſome Authors, of great Fame, have imagined; but to an increaſed oſcillatory Motion in the ſmall Veſſels; whether

whether this arises from some obstructing Matter distracting their Fibres, or acrid Matter irritating them.

An Obstruction, without an Irritation in the obstructed Part, never occasions an Inflammation; but the Irritation of any sensible Part with a sharp Instrument, or acrid Matter, never fails to produce this Effect, although there be no preceding Obstruction, nor Increase of the Heart's Force.

When a larger Artery is tied, in the Operation of the Aneurism, we do not find that the increased Moment of the Blood, in the neighbouring Arteries, produces an Inflammation in the Arm; but when a Tendon is wounded, in Blood-letting, or a little acrid Matter is collected below the Nail; a remarkable Pain, Swelling, and Inflammation of this Member, follow.

However, although an increased Force of the Blood, in the large Vessels, is not the Cause of an Inflammation; yet it is frequently the Consequence of it: For, as often as the Inflammation is large, or the Part inflamed very sensible, the whole nervous System will be so affected by the Pain, as to render the Heart and larger Arteries more irritable, at the same Time that the Blood, now irritated by the Obstruction and Inflammation, must act upon them as a stronger Stimulus than usual.

Hence we may see, why, in Inflammations, the Pulse is often little changed till the Disease has continued for some considerable Time. In Inflammations of the Stomach, Intestines, and Uterus, the Pulse, though much quickened, often continues small: Because, on account of the particular Sympathy between their Nerves and those of the Heart, this Muscle is rendered so irritable, as to contract before its Ventricles are filled with the returning venal Blood.

From

From what has been said, it may appear, that, in the Cure of Inflammations, besides diminishing the Force of the Circulation in general by Blood-letting, a particular Regard is to be had to the Vessels of the Part affected, whose extraordinary Contractions should be lessened by proper emollient and anodyne Applications; and, in many Cases, by blistering the neighbouring Parts.

The ingenious Dr. PRINGLE has often observed the good Effects of Blisters, when early applied, even in Pleurisies, and other internal Inflammations: And I have seen a Blister lessen, remarkably, in twelve or fourteen Hours, the Frequency of the Pulse in an Angina, after Bleeding had done no Service.

I know many Physicians have entertained Prejudices against Blistering in Inflammations, because, by their Irritation, they increase the Force of the Circulation in general: But, not to mention the good Effects they may have, by attenuating the obstructing Matter, and making a considerable Derivation, from serous Humours, from Vessels which are neatly connected, or those of the Part affected, if the Account we have given of Inflammations be true, it must follow, that, altho' the material Cause of an Inflammation, i. e. the acrid or obstructing Matter, be not immediately removed by Blistering; yet, if (according to HIPPOCRATES's Observation) the painful Sensation in the inflamed Vessels be lessened by its Means, the extraordinary oscillatory Motions of these Vessels, and, consequently, the Cause continuing and increasing, the Inflammation must be also lessened. Hence it appears, that a Blister, though it tends to increase the Force of the Circulation in general, may yet lessen the Impetus of the Blood upon the Vessels of an inflamed Part more remarkably, than Blood-letting itself.

What

What has been ſaid of Bliſtering, may be applied, alſo, to Cupping and Scarifying, in Pleuriſies, Anginas, &c.

Sinapiſms, laid to the Soles of the Feet, remove and leſſen Ravings; not by determining the Blood more copiouſly to the inferior Extremities (for their Effect, in this Reſpect, is altogether trifling), but by raiſing a very conſiderable Pain, which ſo affects the Mind, as to render it leſs ſenſible of the unuſual Stimulus or Irritation in the Brain, or its Membranes; i. e. of the Cauſe producing and continuing the Delirium. Nor is it material to what Part of the Body thoſe Cataplaſms are applied: For a ſtrong Delirium, in a Fever, has been removed by the Application of a Sinapiſm, by Miſtake, inſtead of a Poultice of Theriac, to the Region of the Stomach.

We may alſo, from what has been ſaid, ſee how Ravings, Phrenzies, and Madneſs, have been cured by the Power of Muſic, or by a ſudden Fright: For theſe, by greatly affecting the Mind, and fixing its Attention, not only render it leſs ſenſible of the diſordered State of the Brain and its Membranes; but, by the ſtrong Impreſſions they make on the Senſorium Commune, may tend to diſlodge or remove the Cauſe of the Diſeaſe.

LECTURE XXIV.

Of the PULMONES, and their Appendages.

THE Pulmones, or Lungs, are two ſpongeous Subſtances, of a reddiſh Colour in Children, greyiſh in Adults, and bluiſh in old Age, filling the whole Cavity of the Thorax; one being ſeated on the Right, the other on the Left; divided by the Mediaſtinum and Heart, and their Figure anſwering to that of the Cavity which contains them; that is, convex next the Ribs, concave next the Diaphragm, and irregularly flatted and depreſſed next the Mediaſtinum and Heart.

They are diſtinguiſhed into the right and left Lung; and each of theſe into two or three Portions called Lobi, of which the right Lung has commonly three, or two and a Half, and the left Lung two. The right Lung is generally larger than the left, anſwerably to that Cavity of the Thorax, and to the Obliquity of the Mediaſtinum.

At the inferior Margin of the left Lung there is an indented Sinus oppoſite to the Apex of the Heart, which is therefore never covered by that Lung even in the ſtrongeſt Inſpirations; and, conſequently, the Apex of the Heart and Pericardium may always ſtrike againſt the Ribs; the Lungs not ſurrounding the Heart in the Manner commonly imagined.

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The Subſtance of the Lungs is almoſt all ſpongy, being compoſed of an infinite Number of membranous Cells, and of different Sorts of Veſſels ſpread among the Cells, in innumerable Ramifications.

This whole Maſs is covered by a Membrane continued from each Pleura, which is commonly ſaid to be double; but what is looked upon as the inner Membrane, is only an Expanſion and Continuation of a cellular Subſtance.

The Veſſels which compoſe Part of the Subſtance of the Lungs are of three or four Kinds: The Air Veſſels, Blood Veſſels, and Lymphatics; to which we may add the Nerves. The Air Veſſels make the chief Part, and are termed Bronchia.

Theſe Bronchia are conical Tubes, compoſed of an infinite Number of cartilaginous Fragments, like ſo many irregular Semi-circles, connected by a ligamentary elaſtic Membrane, and diſpoſed in ſuch a Manner as that the inferior eaſily inſinuate themſelves within thoſe above them.

They are lined internally by a very fine Membrane, which continually diſcharges a mucilaginous Fluid; and in the Subſtance of the Membrane are a great Number of ſmall Blood Veſſels, and on its convex Side many longitudinal Lines which appear to be partly muſculous, and partly compoſed of an elaſtic Subſtance of another Kind.

The Bronchia are divided, in all Directions, into an infinite Number of Ramifications, which diminiſh gradually in Size; and, as they become capillary, change their cartilaginous Structure into that of a Membrane. Beſides theſe very ſmall Extremities of this numerous Series of Ramifications, we find, that all the ſubordinate Trunks, from the greateſt to the ſmalleſt, ſend out, from

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all Sides, a vaſt Number of ſhort capillary Tubuli of the ſame Kind.

Each of theſe numerous bronchial Tubes is widened at the Extremity, and thereby formed into a ſmall membranous Cell, commonly called a Veſicle. Theſe Cells, or Folliculi, are cloſely connected in Faſciculi, each ſmall Branch producing a Faſciculus proportionable to its Extent, and the Number of its Ramifications.

Theſe ſmall veſicular or cellulous Faſciculi are named Lobules; and as the great Branches are divided into ſmall Rami, ſo the great Lobules are divided into ſeveral ſmall ones. The Cells, or Veſicles of each Lobule have a free Communication with each other, but the ſeveral Lobules do not communicate ſo readily.

The Lobules appear, diſtinctly, to be parted by another cellulous Subſtance, which ſurrounds each of them in Proportion to their Extent, and fills up the Interſtices between them: This Subſtance forms, likewiſe, a kind of irregular membranous Cells, which are thinner, looſer, and broader, than the bronchial Veſicles.

This Subſtance is diſperſed through every Part of the Lungs, forms cellulous or ſpongy Vaginæ which ſurround the Ramifications of the Bronchia and ſanguine Veſſels, and is afterwards ſpread over the external Surface of each Lung, where it forms a kind of fine cellular Tunic, joined to the general Covering of that Viſcus.

Dr. Helvetius firſt obſerved, that when we blow into this interlobular Subſtance, the Air compreſſes and flattens the Lobuli; and when we blow into the bronchial Veſicles, they preſently ſwell; and if we continue to blow forcibly, the Air paſſes inſenſibly into the interlobular Subſtance.

All the bronchial Cells are ſurrounded by a very fine reticular Texture of the ſmall Extremities of

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Arteries and Veins which communicate every Way with each other. The greateſt Part of this admirable Structure is the Diſcovery of the illuſtrious MALPIGHIUS.

The Blood Veſſels of the Lungs are of two Kinds: One common, called the pulmonary Artery and Veins; the other proper, called the bronchial Arteries and Veins.

The pulmonary Artery goes out from the right Ventricle of the Heart; and its Trunk, having run almoſt directly ſuperiorly as high as the Curvature of the Aorta, is divided into two lateral Branches; one going to the right Hand, called the right pulmonary Artery; the other to the left, called the left pulmonary Artery. The right Artery paſſes under the Curvature of the Aorta, and is, conſequently, longer than the left. They both run to the Lungs, and are diſperſed through their whole Subſtance by Ramifications nearly like thoſe of the Bronchia, and lying in the ſame Directions.

The pulmonary Veins, having been diſtributed through the Lungs in the ſame Manner, go out, on each Side, by two great Branches which open laterally into the Reſervoir or muſcular Bag of the right Auricle.

The Ramifications of theſe two Kinds of Veſſels in the Lungs, are ſurrounded every-where by the cellular Subſtance already mentioned, which likewiſe gives them a kind of Vagina; and the Rete Mirabile of MALPIGHIUS is formed by the capillary Extremities of theſe Veſſels. It muſt be obſerved, that the Ramifications of the Arteries are more numerous, and larger, than thoſe of the Veins, which, in all other Parts of the Body, exceed the Arteries, both in Number and Size.

Beſides theſe capital ſanguiferous Veſſels, there are two others, called the bronchial Artery and Vein. The

The Artery has become very famous of late, by the Deſcription given of it by RUYSCH; the Vein was doubted of for ſome Time, but it exiſts as really as the Artery, and may be eaſily demonſtrated.

Theſe two Veſſels are very ſmall, appearing only like very fine Arteries and Veins coming from the Aorta, Vena Cava, and their Branches, in the Manner already ſaid in the Deſcription of the Arteries and Veins; and they ſeem to have no other Uſe but that of nouriſhing the Lungs.

The Varieties in the Origins of the bronchial Arteries and Veins, eſpecially the firſt, are, their Communications or Anaſtomoſes with each other, particularly the adjacent Veſſels, and the immediate Anaſtomoſis of the bronchial Artery with the common pulmonary Vein.

The bronchial Arteries come ſometimes from the anterior Part of the Aorta Deſcendens Superior, ſometimes from the firſt intercoſtal Artery, and ſometimes from one of the Oeſophagææ. They egreſs ſometimes ſeparately, towards each Lung, ſometimes by a ſmall common Trunk which afterwards divides to the right and left, near the Bifurcation of the Aſpera Arteria hereafter to be deſcribed, and follow Ramifications of the Bronchia.

The left bronchial Artery comes pretty frequently from the Aorta and the Right, from the ſuperior Intercoſtal on the ſame Side, becauſe of the Situation of the Aorta; there is likewiſe another which ariſes from the Aorta poſteriorly near

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HELVETIUS has obſerved, that the Ramifications of the pulmonary Artery are more numerous, and larger, than thoſe of the pulmonary Veins; which is the Reverſe in the other Parts of the Body.

the ſuperior Intercoſtal, and above the anterior Bronchialis.

The bronchial Artery gives off a ſmall Branch to the Auricle of the Heart on the ſame Side which communicates immediately with the coronary Artery*.

Sometimes one bronchial Artery gives Origin to ſeveral ſuperior Intercoſtals; and ſometimes ſeveral bronchial Arteries ſend off, ſeparately, the ſame Number of Intercoſtals.

The bronchial Veins, as well as Arteries, were known to GALEN. Theſe Veins are ſometimes Branches of the Azygos, coming from the ſuperior Part of the Curvature. The left Vein is ſometimes a Branch of the common Trunk of the Intercoſtals of the ſame Side, and ſometimes both Veins are Branches of the Gutturalis.

The Lungs have a great many Nerves diſtributed through them by Filaments which accompany the Ramifications of the Bronchia and Blood Veſſels, and are ſpread on the Cells, Tunics, and all the membranous Parts of the Lungs: The Nervi Sympathetici Medii and Majores, commonly called the Nerves of the eighth Pair, or the Intercoſtals, form behind each Lung a particular Intertexture, called Plexus Pulmonaris, from whence nervous Filaments go out, which communicate with the Plexus Cardiacus and Stomachicus.

On the Surface of the human Lungs, between the external and cellular Tunic, we obſerve ſome-

* In the Year 1719, WINSLOW obſerved a very plain Anaſtomoſis between ſome Branches of the left pulmonary Vein and of one of the Arteriæ Oeſophagææ, which came from the firſt left Intercoſtalis, together with a bronchial Artery of the ſame Side.

In that, or the following Year, he remarked likewiſe, an Anaſtomoſis between the left bronchial Artery and the Vena Azygos; and in the Month of April 1721, he ſaw another between a Branch of this Artery and the Body of the juſt mentioned Vein.

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what that looks like lymphatic Veſſels: But we ought to take Care not to miſtake, for ſuch Veſſels, a tranſparent reticular Subſtance obſervable on the Surface of the Lungs after blowing ſtrongly into the Lobuli; this Appearance being entirely owing to the Air which paſſes through the bronchial Veſicles into the interlobular Cells, and which, by ſeparating a certain Number of Lobuli, finds Room to lodge between them. The true lymphatic Veſſels of the Lungs are moſt viſible in Brutes; and in Horſes, particularly, WINSLOW has obſerved one of theſe Veſſels to run along a great Part of one Margin of the Lungs.

Under the Radix of each Lung, that is, under that Part formed by the ſubordinate Trunk of the pulmonary Artery, by the Trunks of the pulmonary Veins, and by the Trunk of the Bronchia, there is a pretty broad membranous Ligament which ties the poſterior Margin of each Lung to the lateral Parts of the dorſal Vertebræ, from that Radix to the Diaphragm.

The Bronchia are Branches or Ramifications of a large Canal, partly cartilaginous, and partly membranous, called Trachea, or Aſpera Arteria. It is ſituated anteriorly in the inferior Part of the Cervix, from whence it runs down into the Thorax, between the two Pleuræ, through the ſuperior Space left between the Duplicature of the Mediaſtinum, behind the Thymus.

Having reached as low as the Curvature of the Aorta, it divides into two lateral Parts, one towards the right Hand, the other towards the left, which enter the Lungs, and are diſtributed thro' them in the Manner already ſaid: Theſe two Branches are called Bronchia, and that on the right Side is ſhorter than that on the left; whereas the right pulmonary Artery is the longeſt.

The Trachea is compoſed of Segments of Circles, or cartilaginous Hoops, diſpoſed in ſuch a Manner, as to form a Canal open on the poſterior Part, the Cartilages not going quite round; but this Opening is filled by a ſoft glandular Membrane, which completes the Circumference of the Canal.

Each Circle is about the twelfth Part of an Inch in Breadth, and about a Quarter of that Space in Thickneſs: Their Extremities are round; and they are ſituated horizontally above each other, ſmall Interſtices being left between them, and the inferior Margin of the ſuperior Segments turned ſuperiorly to thoſe next below them.

They are all connected by a very ſtrong elaſtic membranous Ligament fixed to their Margins. Winslow obſerved the firſt three Segments united into one bent alternately in two different Places, according to its Breadth. Sometimes two are continuous in the ſame Manner.

The Canal of the Aſpera Arteria is lined internally by a particular Membrane which appears to be partly muſcular, and partly ligamentary, perforated by an infinite Number of ſmall Foramina more or leſs imperceptible, through which a mucilaginous Fluid continually paſſes, to defend the internal Surface of the Trachea againſt the Acrimony of the Air which we breathe.

This Fluid is ſecreted from ſmall glandular Bodies diſperſed through the Subſtance of the Membrane, but eſpecially from Glands ſomewhat larger than the former, which lie on the external or poſterior Surface of that ſtrong Membrane by which the Circumference of the Canal is completed. The ſame is obſervable in the Ramifications of the Trachea, from the greateſt to the ſmalleſt.

All the Veſſels of which the Lungs are chiefly compoſed, that is, the Bronchia, or Air Veſſels;

and

and ſanguiferous Veſſels, that is, the pulmonary and bronchial Arteries and Veins, accompany each other through the whole Viſcera.

They are commonly diſpoſed in ſuch a Manner, even to the laſt Ramifications, as that a ſubordinate Trunk or Branch of the Bronchia lies between the like Trunks or Branches of the pulmonary Arteries and Veins; the bronchial Veſſels being immediately connected to the Bronchia. In ſome Places theſe three Kinds of Veſſels touch each other in ſuch a Manner, as to leave a triangular Space in the Middle.

The Bronchia are divided into a very great Number of Ramifications; and the laſt Rami are the Pedicles or Footſtalks of the ſmall Lobuli: All the Lobuli are angular, oblong, broad, thin, &c. The Pedicles ſend out other ſmaller ones, which are very ſhort, and terminate in the bronchial Veſicles or Cells, of which they are Continuations. The ſubordinate Trunks and Rami detach a great Number of theſe Pedicles from their convex Surface.

When we blow into the Lungs, the bronchial Cells neareſt their external Surface appear like ſmall Portions of round Veſicles; and, from this Appearance, all the bronchial Cells have got the Name of Veſicles, though they are all angular, except thoſe which I have now mentioned.

When we examine a Lung uninflated, we find, that the cartilaginous Segments of the Bronchia lie ſo near, as to be engaged in each other; and in drawing out any Portion of the Bronchia by the two Ends, theſe Segments are parted, and the whole Canal is increaſed in Length; but it contracts again, by means of its elaſtic Membrane, as ſoon as that Force is taken off.

When we open lengthways any Portion of the pulmonary Artery and Vein in the same Lung, we meet with a great Number of transverse Rugæ, which are destroyed when these Vessels are elongated. Observed by HELVETIUS.

By Virtue of this Structure, all the Ramifications, both of the Bronchia and pulmonary Arteries and Veins, have constantly the same Direction, whether the Lung be inflated, or collapsed; and they contract, in Length, without being either contorted or folded. In Expiration these Vessels are elongated, and shortened in Inspiration.

These three Vessels lie in a sort of cellular Vagina which accompanies all their Ramifications, and is a Continuation of the interlobular Cells, or cellular Substance in the Interstices of the Lobuli. The Pelliculæ which compose it are, however, disposed there in a more regular Manner, and more longitudinally, than in other Places, and thereby appear to form a true Vagina.

When we blow through a Pipe introduced so far as to touch immediately a Trunk of the sanguiferous Vessels or Bronchia, the Air passes, at first, through all the Cells which lie nearest that Trunk, or its Branches; but, if we continue to blow, it insinuates itself through the whole interlobular Substance.

At the Angle of the first Ramification of the Trachea Arteria, we find, on both the anterior and posterior Sides, certain soft, roundish, glandular Bodies, of a blueish or blackish Colour, and a Texture partly like that of the Thymus, already described, and partly like that of the Glandula Thyroïdes. There are other Glands, of the same Kind, at the Origin of each Ramification of the Bronchia; but they decrease proportionably, in Number and Size: They are fixed immediately to the Bronchia, and covered by the interlobular Substance;

ſtance; and they ſeem to communicate, by ſmall Openings, with the Cavity of the Bronchia.

The Trachea has ſeveral Tunics, as has been already obſerved. The external or common Covering ſurrounds that Part of the Trachea which lies in the Thorax; but out of the Thorax this firſt Tunic is derived from the aponeurotic Expanſions of the Muſcles of the Neck; and it is between this and the following Covering that the Glands, already mentioned, are ſituated.

The ſecond is a proper Tunic, being a Continuation of the cellular Covering of the Lungs; and the Pelliculæ thereof, neareſt the cartilaginous Segments, ſerve them for an external Perichondrium: The third Membrane lies internally, adhering cloſely to the ſame Cartilages, and ſupplying to theſe the Place of an internal Perichondrium.

The fourth Membrane is that which completes the Circumference of the cartilaginous Circles of the Trachea. It conſiſts chiefly of two Laminæ or Strata, partly muſcular, and partly tendinous; the external or poſterior Lamina being formed of longitudinal Fibres, and the internal or anterior, of tranſverſe Fibres. This Membrane is perforated by the ſmall Ducts of the abovementioned Glands, which diſcharge a Fluid, when preſſed; and, being examined through a Microſcope, they appear veſicular or folliculous, much like thoſe of the Stomach.

The Ligaments between the cartilaginous Circles are very ſtrong and elaſtic; and each of them is confined to two Cartilages without communicating with any of the reſt; being fixed to the Margins of theſe Cartilages much in the ſame Manner as the intercoſtal Muſcles are inſerted in the Ribs.

As the Bronchia penetrate into the Subſtance of the Lungs, they gradually loſe their Cartilages;

but the muſcular Lines or Columnæ of MORGAGNI appear as much, and ſometimes more than before. The two Planes abovementioned continue likewiſe to be viſible; and we obſerve very diſtinctly, ſometimes even without a Microſcope, a great many ſmall Apertures in the Pedicles of the Lobuli, and bronchial Veſicles or Cells, which open externally.

RESPIRATION is performed by Organs of two Kinds; one of which may be looked upon as active, the other as paſſive. The Lungs are of the ſecond Kind; and the firſt comprehends, chiefly, the Diaphragm and intercoſtal Muſcles.

As ſoon as the intercoſtal Muſcles begin to contract, the Curvatures of the Ribs are raiſed, together with the Sternum, and placed at a greater Diſtance from each other; by which means the Cavity of the Thorax is enlarged on the two lateral and anterior Sides.

At the ſame Inſtant the Diaphragm is flatted or brought towards a Plane by two Motions, which are apparently contrary; that is, by the Contraction of the Diaphragm, and the Dilatation of the Ribs, into which it is inſerted. The external Surface of the Thorax being thus, in a Manner, increaſed, and the Cavity of the Bronchia being at the ſame Time, and by the ſame Means, leſs reſiſted or preſſed upon, the ambient Air yields to the external Preſſure, and inſinuates itſelf into all the Places where the Preſſure is diminiſhed; that is, into the Aſpera Arteria, and all the Ramifications of the Bronchia all the way to the Veſicles. This is what is called Inſpiration.

This Motion of Inſpiration is inſtantaneous, and ceaſes in a Moment by the Relaxation of the intercoſtal Muſcles; the elaſtic Ligaments and Cartilages of the Ribs bringing them back, at the ſame Time, to their former Situation. This Motion,

tion, by which the Ribs are depreſſed, and brought nearer to each other, is termed Expiration.

The bronchial Arteries and Veins, thro' all their Ramifications, ſurround the Veſicles, tranſmit the Blood thro' their narrow capillary Extremities, and thereby change or modify it, at leaſt in three different Manners.

The firſt Change or Modification which the Blood undergoes in the Lungs is, to have the Coheſions of its Particles extenuated: The ſecond is, to be deprived of a certain Quantity of Serum, which tranſpires through the Lungs, and is what we commonly call the Breath: The third is, to be, in a Manner, reanimated by the Impreſſion of the Air; whether the whole Body of the Air enters the Blood, whether the common Air is only the Vehicle of ſome finer Parts which are conveyed to it, or whether the Air only compreſſes and ſhakes the Blood, as it paſſes round the bronchial Veſicles in the reticular capillary Extremities of the Veſſels.

The Cartilages of the Aſpera Arteria and Bronchia ſerve, in general, to compoſe a Canal, the Sides of which will not ſink in, or ſubſide by, Compreſſion; but will, nevertheleſs, yield to certain Preſſures and Impulſes, without breaking. As theſe Cartilages are not perfect Circles or Rings, and as their Circumferences are completed by elaſtic Membranes, they allow of thoſe Dilatations and Contractions which modulate the Voice; and as they are connected by elaſtic Ligaments of a conſiderable Breadth, the alternate Elongation and Contraction of the Bronchia is facilitated in the Motions of Reſpiration.

I ſhall be more particular, concerning Inſpiration and Expiration, in my next Lecture, on that Subject.

The Larynx

Forms the Protuberance in the ſuperior and anterior Part of the Neck, commonly called Pomum Adami. Anatomiſts term it the Head of the Trachea Arteria; and it is larger, and more prominent, in Men, than in Women.

It is chiefly formed of five Cartilages, the Names of which are theſe: Cartilago Thyroïdes, which is the anterior, and largeſt; Cricoïdes, the inferior, and Baſis of the reſt; two Arytenoïdes, the poſterior and ſmalleſt; and the Epiglottis, which is above all the reſt. Theſe Cartilages are connected by Ligaments; and they have, likewiſe, Muſcles, Glands, Membranes, &c. belonging to them.

The Cartilago Thyroïdæa is large and broad, and folded in ſuch a Manner, as to have a longitudinal Convexity on the anterior Side, and two lateral Portions which may be termed Alæ. The ſuperior Part of its anterior middle Portion is formed into an angular Fiſſure; the ſuperior Margin of each Ala makes a Curvature, and, together with the middle Fiſſure, theſe two Margins reſemble the ſuperior Part of an Ace of Hearts in playing Cards.

The inferior Margin of each Ala is more even, and the poſterior Margins of both are very ſmooth, being lengthened out, both above and below, by Apophyſes, which I name the Cornua of the thyroïd Cartilage. The ſuperior Apophyſes are longer than the inferior, and the Extremities of all the four are rounded like ſmall Heads, which, in the inferior Apophyſes, have a ſhining Surface on the internal Side, reſembling an articular Eminence.

Externally on each Ala, near the Margin, is a prominent oblique Line which runs from behind forwards. The ſuperior Extremity of this Line is near

near the superior Apophysis or Cornu, and both that and the inferior Extremity end in a small Tuberosity, the lowest being often the most considerable. These Tuberosities serve for the Insertion of Muscles and Ligaments. The internal Side of the Alæ, and the convex Side of the anterior Portion, are very uniform; and this Cartilage ossifies gradually in old Age.

The cricoïd Cartilage resembles a kind of thick, irregular Ring, very broad on one Side, and narrow on the other; or it may be compared to a small Portion of a thick Tube, cut horizontally at one End, and very obliquely at the other. I distinguish it into a Basis and Apex, into an anterior, posterior, and two lateral Sides. The Basis is almost horizontal when we stand, and to this the Aspera Arteria is connected, so that the Cricoïdes may be looked upon as the superior Extremity of the Trachea.

The posterior Portion of the Cricoïdes is larger than the rest, and its posterior or convex Side is divided by a longitudinal Eminence, or prominent Line, into two distinct Surfaces, for the Insertion of Muscles: The Apex is gently sloped above this prominent Line, and terminates, on each Side, by a kind of obtuse Angle, formed between it and the oblique Margin of each lateral Portion of this Cartilage. At the superior Part of each of these Angles, there is a very smooth articular Surface, gradually convex.

The whole posterior Side is distinguished into two lateral Portions by two prominent Lines, each of which runs down, almost in a strait Direction, from the articular Surface at the Apex, a little below the Middle of this Side, where it terminates in another articular Line a little concave; and near these four articular Surfaces there are small Tubercles. The two superior Surfaces are for the Articulation

culation of the Cartilagines Arytenoïdææ, and the two inferior for the Articulation of the inferior Cornua or Appendices of the Cartilago Thyroïdes.

The Cartilagines Arytenoïdææ are two ſmall, equal, ſimilar Cartilages, which, connected, reſemble the Spout of an Ewer; and they are ſituated on the Top of the Cricoïdes. In each, we may conſider the Baſis, Cornu, two Sides, one poſterior and concave, the other anterior and convex; and two Margins, one internal, the other external, which is very oblique: The Baſes are broad and thick, and have each a concave articular Surface, by which they are joined to the Cricoïdes.

The Cornua are bent poſteriorly, and a little towards each other: In ſome Subjects they are very looſe, appearing like true Appendices, and eaſily ſeparable from the reſt; between their internal Margins they form a kind of Fiſſure, and their external oblique Margins terminate each by a thick prominent Angle.

The Epiglottis is an elaſtic Cartilage, nearly of the Figure of a Purſlane Leaf, narrow and thick inferiorly, thin and ſlightly rounded ſuperiorly, gradually convex anteriorly, and concave poſteriorly. It is ſituated above the anterior or convex Portion of the Cartilago Thyroïdes, and its inferior Extremity is tied by a ſhort, pretty broad, and very ſtrong Ligament, to the Middle Fiſſure in the ſuperior Margin of that Cartilage. It is perforated by a great Number of Apertures, ſomewhat like thoſe in the Leaves of the Hypericum, or St. John's Wort, which are hid by the Membranes that cover its two Sides.

The Cartilago Thyroïdes is connected to the Cricoïdes by ſeveral ſhort ſtrong Ligaments, round the Articulations of the two inferior Cornua with

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the lateral articular Surfaces of the Cricoïdes; the Apices of the ſuperior Cornua are fixed to the poſterior Extremities of the great Cornua of the Os Hyoïdes, by ſlender round Ligaments, about a Quarter of an Inch in Length.

In the Middle of each of theſe Ligaments we often meet with a ſmall Cartilage of an oval Figure, and much thicker than the Ligaments: The Thyroïdes is likewiſe connected to the Os Hyoïdes by a ſhort, broad, ſtrong Ligament, one End of which is inſerted into the ſuperior Fiſſure of the Cartilage, and the other in the inferior Margin of the Baſis of the Bone: It has alſo two Ligaments at the Middle of the concave Side, which belong to the Arytenoïdææ.

The Cricoïdes is tied inferiorly to the Thyroïdes by a ſtrong Ligament; and, by the Ligaments already mentioned, to the inferior Cornua of that Cartilage: Its Baſis is fixed to the firſt cartilaginous Ring of the Trachea Arteria by a Ligament exactly like thoſe by which the other Rings are connected together; and the membranous or poſterior Portion of the Trachea is likewiſe fixed to the poſterior Part of the Baſis of the Cricoïdes.

The Cartilagines Arytenoïdææ are connected to the Cricoïdes by Ligaments, which ſurround their Articulations with the Apex of that Cartilage: Anteriorly the Baſis of each Arytenoïdes is fixed to one End of a ligamentary Cord, which, by its other End, is inſerted about the Middle of the concave Side of the anterior Portion of the Thyroïdes: At their Inſertions in the Thyroïdes, theſe two Ligaments touch each other, but a ſmall Space is left between them, where they are fixed in the two Arytenoïdes; and they ſeem, likewiſe, to have a ſmall Adheſion to the Apex of the Cricoïdes. This is what is called the Glottis.

Under these two ligamentary Cords there are two others which run likewise from behind forwards: The Interstice between the superior and inferior Cords on each Side form a transverse Fissure, which is the Opening of a small membranous Capsula, the Basis of which is turned externally, that is, towards the Ala of the Thyroïdes: These two Sacculi are the Ventricles mentioned by the Antients, and restored by MORGAGNI, who has given an excellent Description of them. They are chiefly formed by a Continuation of the internal Membrane of the Larynx, and the internal Surface of their Basis sometimes appears to be glandulous.

On the anterior Surface of the arytenoïd Cartilages, there is a small Depression between the Basis and convex superior Part: This Depression is filled by a glandulous Substance, which not only covers the anterior Surface of each Arytenoïdes, but is likewise extended anteriorly from the Basis over the posterior Extremity of the adjacent ligamentary Cord: They are larger and more sensible in some Subjects, than in others; and are covered by the Membrane that lines the adjacent Parts. These Glands were discovered by MORGAGNI.

We have already described the Ligaments that connect the Epiglottis to the Fissure of the Thyroïdes, and to the Basis of the Os Hyoïdes: These two Ligaments, and a third, which ties the Basis of the Os Hyoïdes to the Fissure of the Thyroïdes, form a triangular Space filled with a cellular or fatty Substance, and with small Glands.

The Epiglottis has likewise two lateral Ligaments, by which it is connected to the Arytenoïdes, all the way to their Points, or Cornua: It has also a membranous Ligament, which, running along the Middle of its anterior or concave Side, ties it to the Root or Basis of the Tongue: This Ligament

gament is only a Duplicature of the Membrane that covers the Epiglottis continued to the adjacent Parts. Laſtly, There are two lateral membranous Ligaments belonging to it, fixed near the glandulous Bodies, called Amygdalæ.

The Epiglottis is not only perforated by the regular Foramina already mentioned, but has likewiſe a great Number of ſmall irregular Sciſſures and Breaks, which are ſo many different Lacunæ ſituated between its two Membranes, and filled with ſmall Glands, the excretory Orifices of which are chiefly on the poſterior Side of this Cartilage.

The Larynx gives Inſertion to a great Number of Muſcles, which may be divided into common, proper, and collateral*. The common Muſcles, according to the general Acceptation of that Term, are all thoſe that move the whole Body of the Larynx, one Extremity of them being inſerted in other Parts; and theſe are reckoned to be four in Number, two for each Side; viz. Sterno Thyroïdæi, and Thyro Hyoïdæi, or Hyo Thyroïdæi.

The proper Muſcles are thoſe inſerted wholly in the Larynx, and which move the Cartilages ſeparately: Theſe have been divided various Ways but may be all reduced to eight Pairs.

The Sterno Thyroïdæi are two long, flat, narrow, thin Muſcles, like Ribbons, broader above than below, and ſituated along that Part of the

* By the collateral Muſcles, I underſtand thoſe which are inſerted by one Portion in the Larynx, without appearing to contribute any Thing to the Motions of it. Of this Kind are, the Thyro Pharyngæi, Crico Pharyngæi, &c.

The Larynx may likewiſe be moved by Muſcles which are not immediately inſerted into it, but altogether in other Parts. Such are the Mylo Hyoïdæi, Genio Hyoïdæi, Stylo Hyoïdæi, Omo Hyoïdæi, Sterno Hyoïdæi, and eſpecially the Digaſtrici of the inferior Maxilla; by reaſon of their particular Adheſion to the Os Hyoïdes. It is likewiſe probable, that thoſe Muſcles of the Pharynx which are inſerted in the Baſis Cranii, may, in certain Circumſtances, move the Larynx; in ſome ſmall Degree.

Cervix

Cervix which lies between the thyroïd Cartilage and the Sternum. They are covered by the Sterno Hyoïdæi, and they cover the thyroïd Glands, paſſing immediately before them.

Each Muſcle is fixed, by its inferior Extremity, partly in the ſuperior Portion of the internal or poſterior Side of the Sternum, partly in the Ligament and circumjacent Portion of the Clavicula, and partly in the cartilaginous Portion of the firſt Rib. Sometimes it runs a great way down on the firſt Bone of the Sternum, and croſſes the Muſcle on the other Side; from thence it aſcends on the Aſpera Arteria, cloſe by its Fellow, paſſes before the thyroïd Glands over the cricoïd Cartilage, and is inſerted, by its ſuperior Extremity, into the inferior Part of the lateral Side of the thyroïd Cartilage, and partly along that whole Side*.

The Thyro Hyoïdæi, or Hyo Thyroïdæi, are two flat thin Muſcles, lying cloſe by each other, between and above the former: Each of them is inſerted, by its ſuperior Extremity, partly into the Baſis, and partly into the adjacent Part of the great Cornu of the Os Hyoïdes; and, by its inferior Extremity, into the inferior Part of the lateral Side of the thyroïd Cartilage, immediately above the ſuperior Extremity of the Sterno Thyroïdæus; and both this ſuperior Extremity of the laſt named Muſcle, and the inferior Extremity of the Thyro Hyoïdæus, are, at their Place of Union, confounded a little with the Thyro Pharyngæus Inferior.

The Crico Thyroïdæi are two ſmall Muſcles, ſituated obliquely at the inferior Part of the thyroïd Cartilage: They are inſerted, by their inferior Extremities, into the anterior Portion of the

* Winslow has found this Muſcle double; one diſtinct Portion of it being inſerted into the Baſis, and the other laterally.

cri-

cricoïd Cartilage, near each other; and, by their ſuperior Extremities, laterally into the inferior Margin of the thyroïd Cartilage, at a Diſtance from each other. By this oblique Situation, they repreſent a Roman V.

Each of theſe ſmall Muſcles is, in a Manner, double, its ſuperior Extremity, inſerted into the thyroïd Cartilage, being, in ſome Subjects, very broad, and divided into two Portions, one anterior, the other more lateral, and more oblique: They may likewiſe be eaſily ſeparated into two diſtinct Muſcles; whereof one may be called Crico Thyroïdæus Anterior or Internus; the other Lateralis or Externus.

The two Muſculi Crico Arytenoïdæi Poſteriores are ſituated poſteriorly at the large or back Portion of the Cricoïdes, filling almoſt the two longitudinal Surfaces of that Portion, and diſtinguiſhed by the prominent Line between theſe two Surfaces, already mentioned. Each of them runs up obliquely, and is inſerted, by its ſuperior Extremity, into the poſterior Part of the Baſis of the arytenoïd Cartilage of the ſame Side, near the Angle of that Baſis.

The two Crico Arytenoidæi Laterales are ſmall, and ſituated more laterally than the former. Each Muſcle is fixed, by one End, to the Side of the broad Part of the Cricoïdes; and, by the other, to the inferior Part of the Side of the adjacent Arytenoïdes.

The two Thyro Arytenoïdæi are very broad, each Muſcle being ſituated laterally between the Thyroïdes and Cricoïdes. It is fixed, by a broad Inſertion, to the internal Side of the Ala of the thyroïd Cartilage; and the Fibres, contracting from thence, run from before backward, and from below towards the adjacent arytenoïd Cartilage, in which they are inſerted, from the Glottis to the

Angle of the Basis. In some Subjects, these Muscles cover almost both Sides of the Glottis.

The Arytenoïdæi are small Muscles lying on the posterior concave Sides of the arytenoïd Cartilages*.

The crucial Muscles run each obliquely from the Basis of one arytenoïd Cartilage to the middle and superior Part of the other; the left Muscle covering the right, as is observed by Morgagni, in his first Adversaria.

I look upon these Muscles as superior Crico Arytenoïdæi, because I have always found them partly inserted into the superior circumjacent Portion of the Cricoïdes. The Arytenoïdæus Transversalis is inserted more or less directly by both Extremities, in the two arytenoïd Cartilages; and this I look upon as the true Musculus Arytenoïdæus. Winslow.

The two Thyro Epiglottis cross the Thyro Arytenoïdæi, being inserted into the internal lateral Part of the Thyroïdes, and laterally into the Epiglottis.

The Aryteno Epiglottici are small musculous Fasciculi, each of which is fixed, by one Extremity, in the Head of one of the arytenoïd Cartilages; and, by the other, in the nearest Margin of the Epiglottis.

I never had an Opportunity of examining the Hyo Epiglottici in very muscular Subjects; and therefore I am not sure that the Fibres which go from the convex Side of the Basis of the Os Hyo-

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* Dr. James Douglas, in the first Edition of his Treatise of the Muscles, divided them into two Kinds; one of which he called Arytenoïdæi Majores, the other Arytenoïdæi Minores: And it must be owned, that there is some Variety, in different Subjects. I shall here confine myself to what I have most frequently and most distinctly observed; and that is, that there are two crucial Arytenoïdæi, and one transverse. Winslow.

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ides to the convex Side of the Epiglottis, are really muſculous. WINSLOW.

The Larynx ſerves, particularly, to admit and let out the Matter of Reſpiration; and the Solidity of the Pieces, which it is compoſed of, hinders not only external Objects, but alſo any hard Thing, that we ſwallow, from diſordering this Paſſage. The Glottis, being a narrow Slit, modifies the Air that we breathe; and, as it is very eaſily dilated and contracted, it forms the different Tones of the Voice, chiefly, by means of the different Muſcles inſerted into the Cartilagines Arytenoïdææ, to which the other Muſcles of the Larynx, both proper and common, are Aſſiſtants.

The whole Larynx is likewiſe of Uſe in Deglutition, as ſhall be explained, by means of its Connexion with the Os Hyoïdes, to which the digaſtric Muſcles of the inferior Maxilla adhere; which Muſcles raiſe the Larynx, together with the Os Hyoïdes, every Time we ſwallow; as ſhall be explained, after the Deſcription of the Pharynx and Tongue.

The Facility of varying and changing the Tone of the Voice, depends on the Flexibility of the Cartilages of the Larynx, and decreaſes, in Proportion as we advance in Age; becauſe theſe Cartilages gradually harden and oſſify, though not equally ſo ſoon in all Perſons: And this Change happens not only to the Cartilago Thyroïdes, but alſo to the Cricoïdes and Arytenoïdes.

The Muſculi Sterno Thyroïdæi ſerve, in general, to pull down the thyroïd Cartilage, and the whole Larynx with it: They may likewiſe aſſiſt the Sterno Hyoïdæi in its Actions, and compreſs the thyroïd Gland. The Thyro Hyoïdæi may, occaſionally, either draw up the Larynx towards the Os Hyoïdes, or draw that Bone inferiorly towards the Cartilago Thyroïdes.

It is difficult to determine the Uſe of the Crico Thyroïdæi, from their Situation. They may either pull the Cricoïdes obliquely backwards, or the Thyroïdes obliquely forwards; and, by this Action, the inferior Cornua of the Thyroïdes, and ſmall articular Surfaces of the Cricoïdes, muſt ſlide upon each other.

Both the lateral and poſterior Crico Arytenoïdæi may ſeparate the arytenoïd Cartilages, and thereby open or dilate the Glottis: But they do not both perform this Action in the ſame Manner. The lateral Muſcles ſeparate theſe Cartilages obliquely forwards, and, at the ſame Time, looſen or relax the Sides of the Glottis; but the poſterior Muſcles ſeparate them obliquely backwards, and, at the ſame Time, ſtretch or extend the Sides of the Glottis; and, when both Muſcles act equally, they ſeparate the Cartilages directly.

The Thyro Arytenoïdæi, acting together, draw both the arytenoïd Cartilages forward, and, conſequently, looſen the Glottis, and render it capable of the ſmalleſt Quaverings of the Voice: They may likewiſe, probably, compreſs the lateral Sinuſes or Ventricles of the Larynx, and alſo the arytenoïd Glands.

The Arytenoïdæi bring the arytenoïd Cartilages cloſe together, and preſs them againſt each other; and, when the Cartilages are in this Situation, they may, at the ſame Time, be inclined either forwards by the Thyro Arytenoïdæi, or backwards by the Crico Arytenoïdæi Poſteriores: By this means, the Glottis, when ſhut, may be either relaxed, or tenſe; and, in this laſt Caſe, it is entirely ſhut, as when we hold our Breath in ſtraining: But of this more in another Place.

The general Uſe of the Epiglottis is, to cover the Glottis like a Penthouſe, and thereby hinder any Thing from falling into it when we eat or drink:

drink: And, for this Purpoſe, it is depreſſed in a Manner as ſhall be demonſtrated. It ſerves, likewiſe, to hinder the Air, which we inſpire, from ruſhing directly upon the Glottis; but by ſplitting it, as it were, obliges it to enter by the Sides, or in an oblique Courſe. The Muſcles of the Epiglottis do not appear to be abſolutely neceſſary for that Cartilage; for, in Deglutition, it may be ſufficiently depreſſed by the Baſis of the Tongue; and it may raiſe itſelf again by its own Elaſticity. The Thyro Epiglottici and Aryteno Epiglottici may ſerve to ſhut any lateral Openings that might remain when the Epiglottis is depreſſed by the Baſis of the Tongue; and the Hyo Epiglottici may pull it a little forwards in ſtrong Reſpirations; as Sighing, Maſtication, &c.

Singing is cauſed when the Air, modulated through various Degrees of Acuteneſs and Gravity, is expelled through the Larynx, while it is trembling and ſuſpended between two contrary Powers: And herein lies the principal Difference between the chanting of ſimple Notes, and the Expreſſion of Words. Hence it appears to be a laborious Action, by reaſon of the continual Contractions of the Muſcles, which keep the Larynx in equilibrio; and hence it is, that Singing makes a Perſon hot; becauſe, in acute Tones, the narrower Glottis much retards the Expiration; while, at the ſame Time, a great deal of Air is required to give Strength to the Voice, towards which, again, deep Inſpirations are neceſſary. Hence, likewiſe, the Wind-pipe is rendered very dry, from the quicker Paſſage or Current of Air, to prevent which, a great deal of Muſic is required; and therefore it is, that there are ſuch Numbers of mucous Receptacles in the Larynx; among which, Dr. HALLER is of Opinion, the Veſicles, before deſcribed, ought to be numbered.

Speech is performed by the Larynx at Reſt, or held in the ſame Place, in Tones of Voice differing but little in Acuteneſs and Gravity; but then the Voice is variouſly changed, or modulated, by the Organs of the Mouth. Canorous Speech has a Variation in the Tone or Cadence of the Voice, together with a Modulation of it by the Organs of the Mouth at the ſame Time.

All Speech is reducible to the Pronunciation of Letters, which differ in various Nations, but moſt of them are alike all the World over. Of theſe, ſome are called Vowels, which are made only by an Expreſſion of the Voice through the Mouth, without any Application of the Tongue to certain Parts of the Mouth; but Conſonants are formed by a Colliſion of the Tongue againſt certain Parts of the Mouth, Lips, and Teeth: But, to be more particular in theſe Matters, is beſide our Purpoſe, which will not permit us to expatiate on the beautiful Art of Pronunciation.

That Art, as an extraordinary Inſtance of mechanical Knowledge, has ſo accurately determined all the corporeal Cauſes, concurring to each Letter, that, by Inſpection only, with the Aſſiſtance of Touch, Letters pronounced are underſtood without hearing them, and the attentive Perſon is thereby taught to imitate the ſame Speech by a like Uſe of the Organs.

Whether or no all the Difference of Tone in the Voice depends entirely upon the Length of the Ligaments of the Glottis, increaſed by the ſcutiform Cartilage drawn forwards, and the arytenoïd Cartilage drawn backwards, in ſuch a Manner, that the ſharpeſt are thoſe made by the Ligaments in the greateſt Tenſion; and, therefore, with a quicker Vibration? This had been advanced by the Experiments of ſome Gentlemen of Note, and ſince repeated by other Anatomiſts (who judge that

hat the tenſe Cords or Ligaments of the Glottis do, from the Air perflated by the Wind-pipe, produce the Voice, and its ſeveral Tones, in Animals; ſo that greater Tenſity and Cloſure of the Ligaments yields a more acute Voice, as a Laxity of them occaſions a more grave Tone of the Voice. That thoſe Ligaments, drawn cloſe, ſuppreſs the Voice; or, being half way ſhut, and the reſt open, they give a Tone that is an Octave higher; as a third Part of them, thus ſhut, yields a Fifth higher, &c.) I ſhall not take upon me to determine, in a Matter of ſuch Importance, that has not yet fallen under my Examination experimentally; there are conſiderable Doubts, or Objections, to be made againſt this Syſtem, taken from the cartilaginous and oſſeous Glottis, which is thus immoveable, and in no ways extenſible in Birds; alſo from the Voice becoming infallibly more acute in Whiſtling, merely by a Contraction of the Lips only; as alſo from the Inſtance of Women, who, having a ſhorter Larynx and Glottis than Men, nevertheleſs utter a more ſhrill Voice: Likewiſe from the Experiments, by which it appears, that the Tone becomes more acute by approximating the Ligaments of the Glottis nearer together: Again, from the Doubtfulneſs of the Credit upon which thoſe new Experiments are publiſhed, from the Want of a Machine, of any Perfection, to draw the ſcutiform Cartilage forwards; and, laſtly, from a ſtrong and evident Suſpicion, that the Author of the Experiment imagined the ſcutiform Cartilage to be drawn forwards, when it was, in Fact, only elevated; therefore this Invention merits farther Enquiry. And as the Author's laudable Endeavours are not to be here diſcouraged by a Refutation; ſo neither are they to be haſtily embraced with too much Credulity.

The Strength of the Voice is proportionable to the Quantity of Air blown through the Glottis; and therefore a large Pair of Lungs, eaſily dilatable with an ample Larynx and Trachea Arteria, joined with a powerful Expiration, all conduce to this Effect; but acute and grave Tones of the Voice we obſerve to ariſe from various Cauſes: The former proceeds from a Tenſion and Narrowneſs of the Glottis; and the latter from a Relaxation and Expanſion of it. For thus, in the former, a greater Number of Air Waves are ſplit, in the ſame Time, upon the Ligaments of the Glottis; whence the Tremors, excited at the ſame Time, are more numerous: But when the Glottis is dilated, the contrary of all this follows. Therefore, to produce an acute and ſhrill Voice, the Larynx is drawn up more powerfully, as the Voice is required to be ſharper; inſomuch, that an Inclination of the Head forwards is called in to aſſiſt; by which the Powers of the Muſcles, elevating the Larynx, are rendered more full and effectual.

The Truth of this is confirmed by applying the Fingers to the Larynx when it forms an acute Sound: For then, to raiſe the Voice an Octave, you will eaſily perceive it to aſcend near Half an Inch. The ſame is alſo evident from comparative Anatomy, which demonſtrates the narroweſt Glottis, and the cloſeſt Approximation of Cartilages, in carnivorous Birds; but an ample or broad Glottis in hoarſe Animals, and ſuch as bellow or bleet.

An Inſtance of this we have in Whiſtling; where the Sound manifeſtly becomes more acute by a Contraction, or Narrowneſs, at the Mouth: And alſo in Wind muſical Inſtruments; in which a Narrowneſs of the Mouth, or Opening that expels the Air, with a Celerity of the Wind blown out, are the Cauſes of an acute or ſhrill Tone.

Gravity

Gravity of the Voice, on the contrary, follows from a Depreſſion of the Larynx by the Cauſes already deſcribed; to which add, a broad Glottis, and very ample Larynx. This is evident to the Touch of a Finger applied to the Larynx, when a Perſon ſings; by which the Deſcent of it is manifeſtly perceived to be about Half an Inch for every Octave. Hence the Voices of Males are more grave; and the loweſt Degrees of the Voice degenerate into a Muteneſs, or Whiſpering. Haller. Prim. Lin. Phyſiolog.

LECTURE XXV.

Of RESPIRATION and EXPIRATION; firſt, the Deſcription of the Muſcles employed in theſe Offices*.

THE DIAPHRAGM is a very broad and thin Muſcle, ſituated at the Baſis of the Thorax, and ſerving as a tranſverſe Partition to ſeparate that Cavity from the Abdomen. For this Reaſon, the Greeks termed it Diaphragma; and the Latins, Septum Tranſverſum. It forms an oblique inclined Arch, the anterior Part of which is higheſt, and the poſterior loweſt; making a very acute Angle with the Back.

It is looked upon as a double and digaſtric Muſcle, compoſed of two different Portions: One large and ſuperior, called the great Muſcle of the Diaphragma; the other ſmall and inferior, appearing like an Appendix to the other, called the ſmall or inferior Muſcle of the Diaphragma.

The great or principal Muſcle is fleſhy in its Circumference, and tendinous and aponeurotic in the Middle; which, for that Reaſon, is com-

* WINSLOW has reduced theſe Muſcles to eight only, which is a ſmaller Number than were before.

monly

monly called Centrum Nervum or Tendinosum. It must not, however, be imagined, that this middle Part is of small Extent, or that it is round, because Anatomists have named it the Center; for, in so doing, they had Regard only to its Situation, not to its Form, or the Space it occupies. It is of a considerable Breadth, and represents, in some measure, a Trefoil Leaf; supposing the Part to which the Footstalk is fixed to be sloped, and that this Slope is turned posteriorly, and the middle convex Part anteriorly. Winslow chose to call it, simply, the middle Aponeurosis, or aponeurotic Plane of the Diaphragm.

The muscolous Circumference is radiated, to the Fibres of which it is composed, being fixed, by one Extremity, to the Margin of the middle Aponeurosis; and, by the other, to all the Basis of the Cavity of the Thorax; being inserted, by Digitations, into the inferior Parts of the Appendix of the Sternum, of the lowest true Ribs, of all the false ones, and in the circumjacent Vertebræ.

We have, therefore, three Kinds of Insertions; one sternal, twelve costal, six on each Side, and two vertebral, one on each Side.

These last are very small, and sometimes scarcely perceptible. The costal Insertions join those of the Transversalis Abdominis, but do not mix with them, as they seem to do, before the Membrane, which covers them, is removed. I need not mention here some communicating Fibres of the same Nature with those found in other Muscles; for Instance, between the Obliquus Externus and Pectoralis Major.

The Fibres inserted into the Appendix Ensiformis run from behind anteriorly, and form a small parallel Plane. I have sometimes observed a Fasciculus of Fibres detached from the inferior Side of this Plane, to descend on the internal

ternal Side of the Linea Alba, into which it is inſerted, near the Umbilicus.

The firſt coſtal Inſertion runs a little obliquely towards the Cartilage of the ſeventh true Rib, a triangular Space being left between this and the ſternal Inſertion, at which the Pleura and Peritonæum meet. The Inſertion of theſe Fibres is very broad, taking up about two Thirds of the Cartilage of the ſeventh Rib and a ſmall Part of the Bone, from whence it reaches beyond the Angle of the Cartilage.

The ſecond Inſertion is into the whole Cartilage of the firſt falſe Rib, the third partly in the Bone and partly in the Cartilage of the ſecond falſe Rib, the fourth in the Bone, and ſometimes a little in the Cartilage of the third falſe Rib; the fifth in the Bone and a little in the Cartilage of the fourth falſe Rib, being broader than the reſt.

The ſixth is in the Cartilage of the laſt falſe Rib, and almoſt through the whole Length of the Bone. At the Head of this Rib it joins the vertebral Inſertion which runs from the lateral Part of the laſt dorſal Vertebra to the firſt lumbar. Between this vertebral Inſertion and the ſecond Muſcle of the Diaphragm a ſmall triangular Interſtice is ſometimes left, like that which was mentioned in ſpeaking of the firſt Inſertion: Theſe Inſertions, and that in the laſt falſe Rib, join the ſuperior Extremities of the Pſoas and Triangularis, or Quadratus Lumborum, and ſends off to them ſome communicating Fibres. The common Plane of theſe laſt Inſertions, by the Separation of the third Fibres, form a Foramen through which a Faſciculus of Nerves paſſes.

It is to be obſerved, that the lateral Inſertions of the great Muſcle of the Diaphragm, on the right Side, appear to be lower than thoſe on the left Side; and that the right lateral Portion appears

pears to be larger than the left, as being more arched.

This ſmall Muſcle of the Diaphragm is thicker than the other, but of much leſs Extent: It is ſituated along the anterior Side of the Bodies of the laſt Vertebra of the Back and ſeveral of thoſe of the Lumbars, being turned a little to the Left. It is of an oblong Form, repreſenting, in ſome meaſure, a muſculous Collar, the two lateral Portions of which croſs each other, and afterwards become tendinous towards the inferior Part: The ſuperior Part of the Body of this Muſcle is fixed in the Slope of the middle Aponeuroſis of the great Muſcle. The external Margins of the Alæ, or lateral Portions, join the poſterior Plane of the great Muſcle, and theſe Portions adhere to the Body of the laſt dorſal Vertebra. The Extremities, called likewiſe Crura, or Pillars, are inſerted, by ſeveral tendinous Digitations, into the lumbal Vertebra.

The ſuperior Part of the muſculous Body is formed by a particular Intertexture of Fibres belonging to the Alæ: Theſe two Alæ, whereof that towards the right Side is generally the moſt conſiderable, ſeparate from each other, and form a Foramen Ovale terminated on the inferior Part by Fibres detached from the internal Side of each Ala, immediately above the laſt dorſal Vertebra: Theſe Fibres decuſſate and croſs each other, and afterwards thoſe which come from each Ala join that on the other Side, ſo that each of the Crura is a Production of both Alæ.

The Fibres which come from the left Ala, croſs over thoſe from the right Ala, and this, again, ſends a ſmall Faſciculus of Fibres over thoſe of the left Ala; afterwards the two Crura part from each other.

The

The right Crus is larger and longer than the left, and is always inſerted into the four ſuperior lumbal Vertebræ, and often in the fifth likewiſe, by the ſame Number of Digitations, which become more and more tendinous as they deſcend, and, at length, are expanded in Form of an Aponeuroſis. This Crus lies more on the Middle of the Bodies of the Vertebræ than on the right Side.

The left Crus is ſmaller and ſhorter, and lies more on the Sides of the Vertebræ: It is fixed, by Digitations, to the three ſuperior Vertebræ of the Loins, ſeldom reaching lower; the inferior Part of it is expanded in the ſame Manner as the other, and the two Expanſions ſometimes meet together.

The oval Aperture of this inferior Muſcle of the Diaphragm gives Paſſage to the Extremity of the Oeſophagus, and the Aorta lies in the Interſtice between the two Crura: Immediately above the Aperture a thin Faſciculus of Fibres is ſent off to the Stomach; and ſometimes is obſerved a larger Faſciculus at the inferior Extremity of the Aperture, ſent off chiefly from the right Ala, and accompanied by ſome tendinous Fibres from the left, which ſeemed to run to the Meſentery. In the middle Aponeuroſis of the great Muſcle, a little to the Right of the anterior Part of the Slope, near the ſmall Muſcle, is a round Aperture, which tranſmits the Trunk of the Vena Cava; the Border or Circumference of this Aperture is very artfully formed by an oblique and ſucceſſive Intertexture of tendinous Fibres, almoſt like the Margin of a wicker Baſket; and is, conſequently, incapable either of Dilatation or Contraction, by the Action of the Diaphragm.

We find, therefore, three conſiderable Apertures in the Diaphragm: One round and tendinous, for the Paſſage of the Vena Cava; one oval

oval and musculous, for the Extremity of the Oesophagus; and one forked, partly musculous, and partly tendinous, for the Aorta. The round Aperture is to the right Side, superiorly close to the right Ala of the small Muscle; the oval Aperture is a little to the Left, so that the right Ala, which is between these two Foramina, lies almost directly opposite to the Middle of the Body of the eleventh dorsal Vertebra; the tendinous Fork is under the oval Aperture, but a little more towards the Middle.

This Situation, well considered, will serve to justify, in some measure, the Descriptions and Figures of the antient Anatomists; especially since the right Ala of the small Muscle is larger than the left; and since it was an easy Matter, in taking out the Diaphragm, and spreading it on a Board, to extend it too much towards both Sides.

The SCALENI are compound Muscles, irregularly triangular; and from this Figure the antient Greeks gave them their Name. They reckoned them to be only two in Number, situated laterally on the Vertebræ of the Neck, all the Way down to the first and second true Ribs; afterwards they were divided into six, three lying on each Side; but I have commonly found no more than two on each Side, one lying upon the other; the first of which I name SCALENUS PRIMUS, or PRIMÆ COSTÆ; the other SCALENUS SECUNDUS, or SECUNDÆ COSTÆ.

The SCALENUS PRIMUS is fixed to the superior Part of the external Side of the first Rib by two distinct Portions, commonly called Branches, one anterior, the other posterior: The anterior Branch is fixed to the middle Portion of the Rib, about an Inch from the Cartilage; from thence it runs superiorly oblique, and is inserted into the transverse

verſe Apophyſes of the ſixth, fifth, and ſometimes third cervical Vertebræ.

The poſterior Branch is fixed more poſteriorly in the firſt Rib, an Interſtice, of about an Inch, being left between it and the other Branch, thro' which the axillary Artery and brachial Nerves are tranſmitted; from thence it runs ſuperiorly oblique behind the former, and is inſerted into all the tranſverſe cervical Apophyſes.

The Scalenus Secundus is fixed a little more poſteriorly in the external Labium of the ſuperior Margin of the ſecond Rib, ſometimes by two ſeparate Portions, and ſometimes without any Diviſion; the anterior Portion is fixed immediately under the poſterior Portion of the firſt Scalenus, by a ſhort flat Tendon, united a little with the firſt intercoſtal Muſcle; from thence it runs ſuperiorly over the poſterior Portion of the firſt Scalenus, communicating, likewiſe, with that Muſcle, and is fixed, by Inſertions partly tendinous and partly muſculous, in the tranſverſe Apophyſes of the four firſt cervical Vertebræ.

The poſterior Portion is fixed in the ſecond Rib, more poſteriorly than the other; from thence it runs ſuperiorly, being divided into two Portions, whereof one is inſerted into the tranſverſe Apophyſes of the three firſt cervical Vertebræ, behind the Scalenus Primus; the other Portion runs ſuperiorly behind the former, and is inſerted into the tranſverſe Apophyſes of the two firſt Vertebræ.

The vertebral Inſertions of both Scaleni vary, being ſometimes confounded with each other, and ſometimes with thoſe of the adjacent Muſcles; behind the Scalenus Secundus there is a ſmall muſculous Plane inſerted into the tranſverſe Apophyſis of the laſt cervical Vertebra, and into the

ſecond

second Rib: This does not belong to the Scaleni, but is the first of the Musculi Supra Costales, or Levatores Costarum, as they are commonly called.

In dissecting the anterior Portion of the second Scalenus, I have observed a small Muscle, fixed to the Extremity of the transverse Apophysis of the last cervical Vertebra; which, having run down from thence to the internal and inferior Part of the first true Rib, was slightly inserted there, and seemed to continue its Course to the convex Side of the Pleura. I have likewise seen all the Scaleni inserted into the first Rib.

The Serratus Posticus Superior is a flat thin Muscle, situated in the superior Part of the Back: It is fixed on one Side, by a broad Aponeurosis, to the inferior Part of the posterior cervical Ligament, and to the spinal Apophyses of the two last cervical Vertebræ, and the two first of the Back.

From thence it runs down a little obliquely forwards, and is inserted, by broad musculous Digitations, into the posterior Part of the second, third, fourth, and sometimes fifth true Ribs, near their Angles; but sometimes it has no Insertion into the second Rib. It is covered by, and closely united with, the Rhomboïdes.

The Serratus Posticus Inferior is a flat thin Muscle lying on the inferior Part of the Back. It is fixed in the last spinal Apophysis of the Back, and in the three first of the Loins, by a broad Aponeurosis; from thence it runs superiorly a little obliquely, and is fixed, by musculous broad Digitations, in the last four false Ribs: Its Insertion into the lowest Rib is near the Cartilage, and in the other three near their Angles. It is covered by the Latissimus Dorsi, to which it adheres very

cloſely, and covers the Sacro Lumbaris and Longiſſimus Dorſi.

The Intercostal Muscles are thin fleſhy Planes, lying in the Interſtices between the Ribs, their Fibres running obliquely from one Rib to another: In each Interſtice lie two Planes, an external and an internal, cloſely joined together, nothing but a thin, fine, cellular, membranous Web coming between them.

According to this natural Diviſion, there muſt be forty-four intercoſtal Muſcles in the twenty-two Interſtices left between the twenty-four Ribs; and of theſe there are eleven external, and eleven internal, on each Side: The Fibres of the external Intercoſtals run down from behind forwards, and thoſe of the internal Intercoſtals from before backwards, ſo that the Fibres of theſe two Series of Muſcles croſs each other.

The external Intercoſtals extend commonly from the Vertebræ to the Extremity of the ſuperior Labium of the bony Portion of each Rib, and go no farther; the internal begin anteriorly near the Sternum, and end poſteriorly at the Angle of each Rib.

Therefore, between theſe Angles and the Cartilages, theſe muſculous Planes are double; the Fibres, by their oppoſite Directions, repreſenting the Letter X: But from the Vertebræ to the bony Angles, and in the Interſtices between the cartilaginous Portions, the Plane is ſingle, being that of the external Muſcles poſteriorly, and of the internal anteriorly.

The Fibres of the external Intercoſtals are very oblique near the Vertebræ; but this Obliquity decreaſes inſenſibly towards the anterior Extremities of the Ribs: Their Inſertions begin at the Ligaments by which the Ribs are faſtened to the tranſverſe

verſe Apophyſes. They are a little tendinous, and run for a ſmall Space beyond the Margin, on the external Side of each Rib.

The Fibres of the internal Intercoſtals are, in general, ſhorter, and leſs oblique, than the former: They fill almoſt entirely the Interſtices between the cartilaginous Portions, and are covered externally by a ligamentary Membrane, the Fibres of which, running in an oppoſite Direction to thoſe of the Muſcles, have been miſtaken for Continuations of the external Intercoſtals, over which this Membrane is likewiſe ſpread, only a little diminiſhed in Thickneſs.

Any Portion of the Thorax of an Animal may be boiled ſo much, as that the Fleſh ſhall eaſily part from the Bones; and the Ribs may be drawn out, diſordering neither the Muſcles nor Membranes. But we are not from thence to conclude, that all the Intercoſtals, on one Side of the Thorax, make but one Muſcle; becauſe, by the ſame way of Reaſoning, it might be proved, that all the Muſcles which immediately ſurround the Os Femoris are but one: Since, by a like Experiment, they, together with the Perioſteum, may be entirely ſeparated from the Bone, without breaking their Fibres.

The Supra Costales, commonly called Levatores Costarum, which Name was given them by Steno, but he did not pretend to have diſcovered them; they are irregularly triangular, and ſituated on the poſterior Part of the Ribs, near the Vertebræ.

Each of theſe Muſcles is fixed, by one tendinous Extremity, in the tranſverſe Apophyſis which lies above the Articulation of each Rib, and to the adjacent Ligaments; the firſt being inſerted into the tranſverſe Apophyſis of the laſt cervical Ver-

tebra, and the laſt into that of the eleventh Vertebra of the Back.

From thence the muſculous Fibres run inferiorly oblique, increaſing in Breadth as they deſcend, and are inſerted into the poſterior Part of the external Side of the following Rib: Some of the Fibres often paſs beyond that Rib, and are fixed, in one or more of the Ribs below it, by ſeveral Digitations, which lie at a greater Diſtance from the Vertebræ in Proportion as they run inferiorly; in the inferior Ribs theſe Digitations are more conſiderable than in the ſuperior.

The SUB COSTALES are muſculous Planes of different Breadths, and very thin, ſituated more or leſs obliquely on the internal Sides of the Ribs near their bony Angles, and running in the ſame Direction with the external Intercoſtals.

They are fixed, by both Extremities, in the Ribs; the inferior Extremity being always at a greater Diſtance from the Vertebræ than the ſuperior, and ſeveral Ribs lying between the two Inſertions.

Theſe Muſcles are more viſible in the inferior Ribs than in the ſuperior; and they adhere cloſely to the Ribs which lie between their Inſertions.

The STERNO COSTALES, vulgarly TRIANGULARIS STERNI, are five Pairs of muſculous Laminæ, diſpoſed more or leſs obliquely on each Side the Sternum, on the internal Side of the Cartilages of the ſecond, third, fourth, fifth, and ſixth true Ribs.

They are inſerted, by one Extremity, into the internal Margins of all the inferior Half of the Sternum; from thence the firſt Muſcle, on each Side, runs oblique ſuperiorly, and is fixed in the Cartilage of the ſecond Rib; the ſecond runs leſs obliquely to its Inſertion into the Cartilage

tilage of the third Rib; the reſt are inſerted, in the ſame Manner, into the Cartilages of the following Ribs; their Obliquity decreaſing, and their Length increaſing, in Proportion as they are ſituated lower down; ſo that the loweſt is almoſt tranſverſe.

This laſt Muſcle, which is fixed by one Extremity in the Cartilage of the ſixth true Rib, near the Bone, and ſeems to paſs the Appendix Enſiformis immediately above the Inſertion of the Diaphragm into that Appendix, and to join the Muſcle on the other Side. The ſuperior Portions of the tranſverſe Muſcles of the Abdomen, united with the inferior Sterno Coſtales, have nearly the ſame Appearance; ſo that theſe might be reckoned to belong to the Tranſverſales, did not the Inſertion of the Diaphragm come between them.

Uses of the Muscles employed in Respiration.

In deſcribing theſe Muſcles, we began with the Diaphragm; but its Uſe will be deſcribed laſt.

The Scaleni ſeem better fitted for the Motions of the Neck, than for thoſe of Reſpiration.

The Serratus Posticus Superior is diſpoſed to move upwards the three or four ſuperior Ribs next the firſt; and if any Portion of this Muſcle ſhould be obſerved to be inſerted into the firſt Rib, that could only ſerve for the Motion of the Vertebræ with which that Rib is articulated, and not for the Motion of the Rib itſelf, becauſe of the Stiffneſs and Immobility of its cartilaginous Portion.

The Serratus Posticus Inferior is ſtill better diſpoſed for depreſſing and keeping down the laſt three or four falſe Ribs.

The Uſe which has been aſſigned to theſe two Muſcles, of being Vaginæ or moveable Fræna to the Longiſſimus Dorſi and Sacro Lumbaris, is without Foundation; for the Portions of theſe Muſcles, covered by the Serrati, have no more Need of ſuch a Contrivance, than thoſe which are not covered by them.

The poſterior Fibres of the external INTERCOSTALS are fixed, by their ſuperior Extremities, ſo near the Articulation of the Ribs with the Vertebræ, that they cannot depreſs that Rib into which they are ſo inſerted; whereas the Inſertions of their inferior Extremities into the following Rib, being at a greater Diſtance from the Articulation, they may move that Rib upwards: And from thence it follows, that all the remaining Part of each external Intercoſtal, which terminates at the oſſeous Extremity of each Rib, can only ſerve to raiſe the inferior Rib towards the ſuperior.

The anterior Fibres of the internal INTERCOSTALS are ſo near the Articulation of the Ribs with the Sternum, that they cannot depreſs that Cartilage into which each of them is inſerted; whereas the inferior Inſertions of theſe Fibres, being at a greater Diſtance from the Articulation, they are in a Condition to raiſe the Cartilages into which they are ſo inſerted: From whence it follows, that all the internal intercoſtal Muſcles have the ſame Uſe with the external; and that they can have no other.

The Portions which lie between the two Extremities of the Ribs, ſerve to increaſe the Force of the ſame uniform Action: And the firſt Rib, being immoveable, ſerves for a fixed Point for the Motions of all the other Ribs; and each Rib, in particular, ſerves for a fixed Point for the Motion of that below it.

The

The SUPRA COSTALES are powerful Assistants to the Intercostals, in their common Action; and are, therefore, very properly termed LEVATORES COSTARUM.

But we must not confound with these, a small Muscle immediately above the first Rib, which, by its Insertion into that Rib, looks like them, at first Sight.

The Insertions and Direction of the STERNO COSTALES, being carefully examined, it will be found, that their Use is, to depress the cartilaginous Portions and anterior Extremities of the Ribs, especially the superior ones, except the first; and, at the same Time, to draw the Cartilages of the inferior Ribs near to the Sternum, by reason of the Curvature. They may, therefore, very well be called DEPRESSORES COSTARUM, as the Supra COSTALES are named LEVATORES.

The SUB COSTALES have the superior Extremities of their Fibres much more distant from the vertebral Articulations of the Ribs than the inferior ones: Whence it follows, that they can more easily move the superior than the inferior Ribs; and, consequently, that they are Assistants to the Sterno Costales.

The DIAPHRAGM, together with the INTERCOSTAL MUSCLES, RIBS, STERNUM, and DORSAL VERTEBRÆ, form the Cavity of the THORAX; and it divides this Cavity from that of the ABDOMEN.

Its particular Use is, to be the principal Organ of Respiration; that is, of the alternate Expansion and Contraction of the Thorax.

The other Muscles, already mentioned, are to be considered only as Assistants and Directors, in order to facilitate and regulate the Motions which, in the ordinary State, are perpetual; but which may, by the Action of these other Muscles, be

accelerated, retarded, or even ſuſpended, for ſome Time.

The Diaphragm may move when the Ribs are at Reſt; and, conſequently, without the Aſſiſtance of the Muſcles which move the Ribs; and this Motion may be ſufficient to keep up the alternate Dilatation and Contraction of the Thorax; without which, an Animal cannot live.

In a Word, we may continually inſpire and expire, by means of the Diaphragm, whether the Ribs move, or remain at Reſt; and whether the Thorax be kept, for a conſiderable Time, in a State of great Dilatation, or great Contraction: For this does not hinder the Diaphragm from continuing its Motions.

Of Inspiration and Expiration.

The Quantity of Blood which enters the Lungs is exceeding great; equal to (or even, perhaps, greater than) that which is ſent, in the ſame Time, throughout the reſt of the whole Body: Which therefore demonſtrates ſome very conſiderable Uſes proper to this Viſcus.

And that this Uſe depends manifeſtly upon the Air, appears, from the univerſal Conſent of Nature; in which we ſcarce find any Animal without Breathing: Alſo, from the Structure of the Lungs in a Fœtus; in which, for want of Air, they are uſeleſs; receiving only a ſmall Portion of the Blood which the pulmonary Artery conducts from the Heart.

We ſhall now, therefore, ſpeak of the Nature of Reſpiration; by which the Air is drawn into, and expelled from, the Lungs.

The Element of Air appears, from the Principles of Philoſophy, to be an elaſtic, inviſible, and ſonorous Fluid; but the atmoſpherical Air, which

which we commonly receive into the Lungs, is impure, filled with a great Quantity of aqueous Vapours, the Seeds of Plants and Animals, and other heterogeneous Bodies, but in very minute Particles; ſo that its ſpecific Gravity is about 850 Times leſs than that of Water.

This Air, which ſurrounds the Earth on all Sides, being preſſed by the incumbent Columns of its own Maſs, perpendicularly, laterally, and in all poſſible Directions; enters, wherever it meets a leſs Reſiſtance, with a conſiderable Force; as appears, from Experiments made with empty or exhauſted Veſſels, and by the Air Pump.

This Air is excluded from all Parts of the human Body by the ſurrounding cloſe Skin, which, even when dried, or tanned, is impervious to the Air; but more ſo as under the Skin is placed the Fat, making an equal Reſiſtance to the narrow Openings of the abſorbing Veſſels.

It therefore now remains for us to enquire, Why the Air enters the Lungs of an adult Perſon? For with this they are, in a Manner, conſtantly full; and, conſequently, are equally preſſed, and reſiſting the Weight of the whole Atmoſphere. But that the Lungs always contain Air, is evident; becauſe, how cloſe ſoever you compreſs them, they will ſtill be ſpecifically lighter than Water; and even in a Fœtus, after they have been inflated but a ſmall Number of Times, they always ſwim: Whereas, before Breathing, they ſink in Water, if they have not, as yet, given Admittance to the Air.

The Equilibrium of the Air's Preſſure being removed in any Place, it conſtantly deſcends or flows that Way where it is leaſt reſiſted: Therefore, for the Air to enter the Lungs, they muſt make a leſs Reſiſtance to it than before; namely, the Air, which is already in the cellular Fabric of the

the Lungs, must be rarefied: But this Effect will follow, if the Cavity of the Thorax, in which the Lungs are contained, and which they exactly fill, be dilated. Thus the Air, which is always in the Lungs, expands into a larger Space; by which means, being weakened in its Spring, it makes a less Resistance to the external Air; and, consequently, a Portion of the said external Air descends into the Lungs sufficient to restore the confined and rarefied Air, filling the Lungs to the same Density with that of the external Air.

We have hitherto surveyed the Powers which are able to increase the Capacity of the Thorax in all its Dimensions; it therefore remains, that the Air, which is a heavy Fluid, and pressed on all Sides by the incumbent Columns of the Atmosphere, must now enter the Thorax or Lungs by the greater Force which it has over that little rarefied Air already in the Lungs; or yet more powerfully, if they contain no Air at all. In this Action, therefore, which is called Inspiration, the Bronchia, or Branches of the Wind-pipe, are every way increased, both in Length and Diameter; because all the Diameters of the Thorax are increased: But, in this Act, the inflated Lungs always follow closely contiguous to the Pleura, without leaving any intermediate Space: At the same Time the pulmonary sanguineous Vessels, which are wrapped up, together with the Bronchia, in a Covering of the cellular Substance, are likewise, with them, extended in Length, and spread out from smaller into larger Angles; by which means, the Circulation thro' them is rendered easier. Whilst this is performing, the vesicular Substance, or Flesh of the Lungs themselves, filled with Air, increases those Spaces thro' which the capillary sanguineous Vessels of the Lungs make their Progress; whereby the vesicular

Pressure,

Preſſure upon each other, and upon the adjacent Veſſels, is diminiſhed: Thus, therefore, the Blood will flow, with a greater Celerity, into and thro' the larger and ſmaller Veſſels of the Lungs. Hence, we obſerve, the Pulſe is quicker, during the Time of Inſpiration. But as for the Preſſure of the Air upon the Blood in the Lungs, in this Action, it is ſo inconſiderable, as not to deſerve our Notice*.

It is doubted by ſome, whether there be not Air between the Lungs and Thorax; and whether this Air, being rarefied in Inſpiration, is not afterwards condenſed, ſo as to compreſs the Lungs, and cauſe Inſpiration. And they again aſk, Whether this Opinion be not confirmed by the Inſtances of Birds, in which we find this Matter to be truly ſo? But we ſee every Thing concurs to confute this Opinion.

For, 1. Immediately behind the Pleura, in living Quadrupedes, as well as in dead human Bodies, the Lungs are contiguouſly viſible to the naked Eye, without any intermediate Space between them; but, the Pleura being perforated, the Lungs are immediately, by the contiguous Air that enters, preſſed together towards the Vertebræ.

2. Large Wounds, admitting the Air only into one Cavity of the Thorax, diminiſh Reſpiration; but ſuch Wounds as let the Air into both Cavities, quite ſuffocate or ſuppreſs Reſpiration.

3. The Thorax, being opened under Water, ſends out no Bubbles of Air thro' the ſaid Water.

Again, 4. The imaginary Space between the Lungs and the Thorax is always filled with a

* The Preſſure of the Atmoſphore is never (naturally) ſo much increaſed, as to urge the Air through the Pores of the Lungs into the Blood, as it may eaſily be forced, by Art, with a Syringe; although ſome of the Air may be ſubſtantially expelled or abſorbed this Way, as it is in common through the Pores of all other Bodies, whilſt it approaches to a ſolid or fixed Plate.

watery

watery or ſerous Vapour, or elſe by the ſame Vapour condenſed into a watery Lymph.

5. If the Lungs adhere, they injure Reſpiration but in a ſmall Degree; which ought entirely to ceaſe, if it requires an intermediate Air between the Lungs and Thorax.

6. Finally, The external Air, being admitted into any of the internal Membranes of the human Body, deſtroys their Texture, if they are not defended by a plentiful Mucus; of which we can find none, either upon the Surface of the Lungs, or of the Pleura.

After the Thorax has been every Way dilated, by the ſaid Powers, as far as it well can be, or as far as is ſufficient for the Purpoſes of Life and Death; the Air, thus received into a Place conſtantly near thirty Degrees hotter than itſelf*, grows warm there from the Blood, from which it acquires about fifteen Degrees of Heat: Therefore the Air, thus expanding the Cells to their utmoſt Extent, whoſe Dilatation, at the ſame Time, meets with no empty Space in the Thorax; the Blood, thereupon, begins to be ſtopped, by the Air's Expanſion (being then rarefied and expanded to a twelfth Part of its former Bulk), compreſſing the leaſt Veſſels; by which means, a new Reſiſtance ariſes to the Blood, perpetually flowing from the Heart into the Lungs: And therefore we ſee, in hard Straining, and long Retenſions of the Breath, the Blood ſtagnates in the Veins, eſpecially about the Head, before the right Side of the Heart, which is now ſhut, becauſe unable to empty

* The middle Degree of the Air's Heat, in the northern Countries of Europe, mounts the Thermometer to about 48 Degrees, while the mean Heat of the expired Air from the Lungs is 94 Degrees; of which, the Difference, 46 Degrees of Heat, is gained by the Air from the Blood; ſince the Breath ſeems to have the ſame Heat with the Lungs, in its Contact.

itſelf

itself into the Lungs; whereupon the Face swells, looks red, and sometimes the Veins of the Brain, Neck, Intestines, Kidneys, Lungs, or even the right Auricle itself, will be bursted with Violence.

Such is the Cause of Death, in those who are suffocated by compressed Air, by drowning in Water, or by strangling with Cords. Therefore that Anguish or Uneasiness which arises from the Stoppage of the Blood in its Course through the Lungs of a healthy Person, is the Occasion which excites him to open or relax again the Powers of Inspiration, and immediately to stir up the Forces which concur to Expiration, thereby to free the Thorax and Lungs from the too much rarefied Air.

The Powers concerned in Expiration are, chiefly, the oblique Muscles of the Abdomen, together with the Recti and transverse ones. The former of these are, in one Part of them, fastened to the inferior Ribs; and, in another Part, they are attached to the Os Pubis and Ilium, as a fixed Point with Respect to the Breast: Therefore the Musculi Recti, being contracted, depress the Arch or Convexity into which the abdominal Viscera are thrust by the Diaphragm, and bring the same nearer to a strait Line; and, at the same Time, the abdominal Viscera are pressed by those Muscles, superiorly and posteriorly, against the Diaphragm, which, alone, is able to give way and yield up into the Thorax, which, at that Time, is rendered shorter. The oblique Muscles, for the same Reasons, compress the lateral Parts of the Abdomen, and urge the Liver, Spleen, and Stomach, superiorly; and, lastly, they draw down the Ribs, which were before elevated by the Intercostals. The transverse Muscles, indeed, do not draw down the Ribs; but they pull the Cartilages of the false Ribs a little internally, and render the whole Capacity

pacity of the Abdomen leſs; whilſt, at the ſame Time, they urge the Viſcera againſt the Diaphragm. By theſe Means, the Thorax, contrary to its former State, is every way rendered narrower and ſhorter, ſo as to expel as much Air out of the Lungs as is ſufficient to relieve the Uneaſineſs cauſed by its Retention. At the ſame Time, the muſcular Fabric of the Bronchia exerts a Power of Contraction againſt the diſtending Air, ſo as to promote its Expulſion; and the Ribs themſelves likewiſe returning, by their Elaſticity, to that Situation and Reſt which their Articulations require in a State of Expiration, do all of them fly upwards together, as ſoon as the extending Powers ceaſe; whereupon, their Elaſticity reſtores them ſpontaneouſly to their reſpective Places, during Expiration. From hence Expiration becomes eaſier than Inſpiration, and quicker in the Proportion of two to three; and from hence it remains always as the laſt Act in a dying Perſon. The triangular Muſcle, alſo, of the Sternum, by elevating the Cartilages of the true Ribs, together with the Sternum itſelf, which they draw upwards and backwards, has ſome ſmall Share in this Action.

In a more powerful Reſpiration*, when the Inſpirations are made wilfully greater, the Expirations are likewiſe increaſed by the Aſſiſtance of ſome other Powers, as the Sacro Lumbalis, Longiſſimus, and Quadratus Muſcles of the Back and

* We are very ſenſible, that, in Efforts where great Strength is requiſite, we ſuſpend Reſpiration, in retaining as much Air as poſſible in the Lungs, and by the extreme Tenſion of all the Organs ſubſervient to Reſpiration at that Time, that we explain how the Italian Woman, ſeen in London, could bear ſo great a Weight upon her; and the Man, I ſaw at Paris, lying on a Plank ſupported only at both Ends, and having on his Breaſt an Anvil of ſix Hundred Pounds Weight; and ſuffers a Bar of Iron to be beat on the Anvil with large Hammers.

Loins.

Loins. This Force, by which the Air is blown out of the Lungs through a Tube, is ſufficient to carry a leaden Bullet, weighing above a Dram, to the Diſtance of one Hundred and Sixty Yards; but, in a healthy Perſon, the Muſcles of the Abdomen alone ſuffice to an eaſy Expiration, in which the Lungs are not ſo much emptied of Air as they are by a violent Efflation.

The Effects of Expiration are, a Compreſſure of the ſanguiferous Veſſels in the Lungs, a Reduction of the Bronchia or Branches of the Wind Artery into more acute Angles, a Preſſure of the reticular ſmall Veſſels by the Weight and Contact of the adjacent larger Veſſels; by which means Part of the Blood, heſitating in the capillary Arteries, is urged forwards through the Veins to the left Side of the Heart; whilſt, at the ſame Time, that Part of the Blood is reſiſted which flows in by the Artery from the right Ventricle. For we ſee, by Experiment, that if the Lungs are not inflated, they are never well filled by Injections, which always ſucceed beſt, by cauſing the Lungs to imitate vital Reſpiration*.

In this Manner a freſh Neceſſity follows for repeating Reſpiration; becauſe the collapſed Veſſels of the Lungs reſiſt the Blood repeatedly expelled from the right Ventricle of the Heart; and this makes another Cauſe of Death in thoſe Animals which expire in Veſſels exhauſted of Air. For in ſuch, the Lungs, having the Air drawn out from them, appear denſe, ſolid, and heavier than Water; whence they are rendered impervious to the Blood. Of the ſame Kind is the Death of thoſe who are

* Does not, therefore, the Blood ſeem to flow quicker thro' the Lungs, than thro' other Parts of the Body? And is not this made probable, from the Quantity of Blood, and the Shortneſs of its Courſe, in going from the right to the left Ventricle.

de-

deſtroyed by Lightning. Thus, therefore, by the Power of a moſt wiſe Fabricature, the Organs of Expiration are relaxed, as ſoon as that Uneaſineſs is perceived which ariſes from the Hindrance of the Blood's Courſe thro' the Lungs; and, thereupon, the Powers of Inſpiration are excited to Action, whereby the Courſe of the Blood through the Lungs is rendered free and quicker*.

It is by ſome queſtioned, Whether there are not other Cauſes of alternate Reſpiration? Whether we may hope for any Diſcovery in this Matter, by compreſſing the Vena Azygos, the phrenic Nerve, or intercepting the Blood ſent to the Brain? But thoſe are repugnant to comparative Anatomy; by which we always find the ſame Alternation in the Breathing of an Animal, independent of any ſuch Nerve or Vein. Whether Reſpiration is from the alternate Contraction of the antagoniſt Muſcles, among which thoſe of Expiration relax the others of Inſpiration, and the contrary? But, in this Manner, all the Muſcles of the human Body are perpetually in an alternative Motion.

From what has been hitherto ſaid it appears, that Reſpiration is unavoidably and abſolutely neceſſary to Life in a healthy adult Perſon: Becauſe, whether the Lungs remain long in a State either of Expiration or Inſpiration, we ſee that Death will be the Conſequence. Therefore no Animal, that has Lungs like ourſelves, after it has once breathed, can ſubſiſt longer than a few Minutes without the Uſe and Benefit of a free Air; but it will either periſh, or, at leaſt, fall into ſuch a State as differs

* A denſe Air will preſerve Life much longer than that which is rarefied; becauſe the former more eaſily and ſpontaneouſly enters and diſtends the Lungs; whilſt the latter, being unable to overcome the Reſiſtance of the Air Veſſels and confined Breath, is excluded: Yet a healthy Perſon can, without much Difficulty, ſupport any Air that has but Half the common Denſity of the Atmoſphere.

from

from Death only in its being recoverable again by certain Powers or Actions.

But the Uſe of Reſpiration is different from this Neceſſity, which Nature might have avoided, either by uſing no Lungs at all, or elſe by diſpoſing them in a Manner reſembling thoſe of a Fœtus. This Uſe, therefore, of Reſpiration, muſt be very conſiderable; ſince all Animals are either made with Lungs, or Gills, as in Fiſhes; or elſe with a Wind-pipe diſperſed through all Parts of the Body, as in Inſects.

In order to diſcover this immediate Uſefulneſs of Reſpiration in Man, let us compare the Blood of an adult Perſon to that of a Fœtus, and alſo with the ſame vital Fluid in Fiſhes. It appears, then, in a Fœtus, that the Blood is deſtitute of its florid Redneſs, and ſolid Denſity; and in Fiſhes we obſerve, that there is neither Heat nor Denſity, and but little Craſſamentum contained in it; and therefore all theſe Properties, we are, by the Nature of Things, perſuaded, the Blood acquires in the Lungs.

It follows, therefore, that our Blood acquires its Heat, principally, in the Lungs; for that all Animals, which have Lungs, and two Ventricles in the Heart, have the Heat of their Blood commonly twice as great as that of the Atmoſphere*. But does not this ariſe from the alternate Extenſion and Contraction, Relaxation and Compreſſion, of the pulmonary Veſſels, by which the ſolid Parts

* Thus, in the ſame northern Seas, we obſerve, that thoſe Fiſhes, which have no Lungs for Breathing, are as cold as the Element, although their Flight and Motion through the Waters be ever ſo ſtrong and rapid; but, at the ſame Time, thoſe of the Whale Kind, which breathe with Lungs, have their Blood warm, like that of a Man, although they remain almoſt ever ſleepy and ſluggiſh. Neither the Heart, therefore, nor all the reſt of the Body, are able to generate the Heat of the Blood without the Aſſiſtance of the Lungs.

of the Blood are perpetually rubbed together, and cloſely compreſſed in the Attrition that is made during Expiration, as it is more rapidly moved and ground together during Inſpiration.

Nor is it any Objection to this, that Water cannot be made to grow hot by any Friction: Nor, in Reality, is that Aſſertion true. For Water, by violent Winds and Motion, as well as Milk, acquires ſome Degree of Warmth; and the Blood, which is ſo much more elaſtic and inflammable than Water, muſt, of Courſe, acquire a much greater Heat. Nor does the Heat of the Blood proceed from an Efferveſcence: For only the muſcular Motion being increaſed, or even merely by an increaſed Uſe of the Organs of Reſpiration, the Heat of the Blood is augmented; as it is diminiſhed in Proportion as thoſe Actions are diminiſhed, and ſoon ceaſes when they are wholly ſuppreſſed.

The Denſity of the Blood is, indeed, again promoted in the Lungs, partly by the copious Diſcharge of the aqueous Vapour, which is there ſeparated, and expelled from the pulmonary Veſſels, by which the reſt of the Maſs will become ſpecifically heavier; but the ſame Effect ſeems to follow, more eſpecially, from the Attrition and Preſſure which the Blood here ſuffers in being alternately retarded, accelerated, and figured, in its Courſe through the modulating Tubes of the leaſt Veſſels, which give a Sphericity and Denſity to the Particles. And, in this Reſpect, the pulmonary Vein, being ſmaller than its correſponding Artery, is of no ſmall Uſe towards increaſing the Attraction of Coheſion between the Parts of the Globules, ſo as to compreſs and bring them cloſer to each other.

But it is well known, by the Experiment of Sir Isaac Newton, that Redneſs is increaſed by a greater

greater Density of Particles: From hence it is, that the Redness, Heat, and Density of the Blood, are always proportionably increased together by muscular Motion, or Exercise, with which the Motion of the Lungs, in Respiration, necessarily corresponds and increases*.

It is therefore queried by some, Whether the Air itself is not received by the Blood in the Lungs, so as to excite necessary Vibrations therein? Whether this does not appear from the Resistance of Bodies to the heavy external Air, and from the Air found in the Blood Vessels, in the cellular Substance, and certain Cavities of the human Body? Also, from the Cracking observed by an Extension of the Joints? To which add, the Air manifestly extravasated from the Wind-pipe into the Hearts of certain Animals, as the Locust; together with the Necessity of a vital Oscillation in the Blood itself? And, lastly, the increased Redness of the pulmonary Blood?

Contrary to all this, it is evident, that the Blood here receives no Air into itself; partly from the Minuteness of the inhaling Vessels, with the Mucus that perpetually lines the Sides of the Vesicles in the Lungs; to which add, the Nature of the elastic Air itself, which is very unapt to pass thro' capillary Vessels, with a Repulsion of it by Water, which hinders it from passing thro' Paper, Linen, Cloth, or Skins, which are wetted by Water.

Again; the Air, being driven into the Wind-pipe, never passes to the Heart; or, whenever it does, it is forced thither by some great or unna-

* But that there is some small Difference between the Blood of the Lungs and that of other Parts, is argued from many Experiments; and, particularly, extreme Cold there condenses the Blood, in some Degree. Add to this, its Difference from the thin, aqueous, and light Blood of Fishes.

tural Violence: But the permanent Air in the Veſſels and Humours of the human Body, from a State of Inelaſticity, may become elaſtic by Putrefaction, Froſt, or an external Vacuum: But ſuch permanent unelaſtic Air is incorporated with all Liquors, and taken into our Bodies with the Aliments and abſorbed Vapours mixing ſlowly, and with ſome Difficulty. But there never were any elaſtic Bubbles of Air obſerved in the Blood of a living Animal; and ſuch Air, being inflated into the Blood Veſſels of any living Animal, kills it ſpeedily. Nor is there any Certainty of the Blood in the pulmonary Veins being of a brighter red Colour.

Whether the Blood is cooled in the Lungs; and whether this ſeems to be true from the Death of Animals in Air which is heated to ſuch a Degree as equals the Heat of the hotteſt Breezes in the moſt ſultry Dog Days? And whether the pulmonary Veins are not, therefore, leſs than the Arteries? That the Blood is cooled in the Lungs, is thus far true; in that it there communicates fifteen Degrees of its Warmth to the contiguous Air.

But that this was not the principal Deſign of Nature here, upon the Blood, is evident; ſince no one will ſay, that the venal Blood is hotter than the arterial; although ſome pronounce the former to be ſomewhat cooler. Since, therefore, the venal Blood enters the Lungs; if it be there cold, it will follow, that the Arteries muſt receive it ſtill colder.

But, then, here the Degrees of Heat, which the Blood communicated to the Air, are again recovered by it; and, indeed, a Man may live in an Air much hotter than the Blood itſelf. We ſee, that the greater Capacity of the right Ventricle and pulmonary Artery was neceſſary to reſerve and

retard

retard the Blood, as the pulmonary Vein, being narrower, accelerates it.

Whether the Use of the Lungs is, to absorb a Nitre, from the Air, to the Blood? or Whether the florid Colour, observable on the Surface of a Cake of Blood, be owing to the same Cause, while the inferior Part looks of a dark and blackish Colour? remain Questions, with some.

That there is a kind of volatile Acid in the Air, is certain; since that, meeting with a suitable Earth, forms Nitre. For a nitrous Earth, being exhausted of its Salt, and exposed again to the Air, becomes impregnated with more Nitre: But the same universal Acid, we know, by certain Experiments, meeting with a different Sort of Earth, forms a vitriolic Salt, or else Sea Salt. For the Caput Mortuum of Sea Salt, which remains after the Distillation of the Spirit, recovers so much Strength from the Air, as enables it to yield more Spirit by Distillation; even in Snow there is a cubical Salt, but Marcasites sweat out a true Vitriol, and Colcothar recovers again the acid Spirit which was drawn from it: Also, fixed Alkali, exposed to the Air, turns into a vitriolic Tartar.

This, therefore, cannot be the Use of Respiration; because those Salts abound in too small a Quantity of Air for such Uses: And that Air is fittest for Breathing which is (perhaps) on the Tops of the highest Mountains, where those Salts are to be found in the least Quantities; nor is there any nitrous Salt, as yet, known to be found in our Blood.

As for the superior Part of the Surface of the Cake of Blood appearing of a bright florid Colour; that arises from a Relaxation or looser Disposition of the spherical Globules there, while the inferior Part appears black; because the Globules

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are there more compreſſed and condenſed by the other incumbent Parts.

If it be aſked, Why Tortoiſes, Frogs, Lizards, Snails, Earwigs, and other Inſects, live long without Air? We anſwer, That in them the Lungs are given not ſo much for the Preparation of the Blood, which they receive but in a very ſmall Quantity, as for the Uſe of Swimming: And from hence it is that their Lungs are immediately joined with the Vena Cava and great Artery. But Inſects, we know, draw the Air in, and exhale it again thro' their Skin. If it be aſked, Why all Animals periſh in Air that is confined, or not renewed, altho' the Animal be ſmall; ſuch as little Birds? We anſwer, Becauſe the Air which has once entered the Lungs, and been made foul by aqueous Vapours, is rendered leſs elaſtic, and unfit for Reſpiration, by alkaline Vapours. Hence it is, that an Animal ſurvives longer in Air that is more compreſſed than that of the Atmoſphere: For, in that Caſe, there is a greater Proportion of the elaſtic Element, which takes up a longer Time to be corrupted. But, even in other Caſes, confined Air is rendered deſtructive only by Stagnation, and filling it with Vapours: And the Reaſon why Animals ſwell in an exhauſted Veſſel, is, from the Extrication and Expanſion of the unelaſtic Air lodged in the Blood and other Juices.

There is a certain Conſent or Proportion between the Pulſe and Reſpiration; that, according to the common Courſe of Nature, there are three or four Pulſes counted to one Reſpiration: But if more Blood is ſent to the Heart, in a given Time; the Numbers, both of the Pulſe and Reſpiration, are increaſed. This is the Cauſe of panting or ſhort breathing in a Perſon that exerciſes his Body with any conſiderable Motion, whereby the venal Blood is returned faſter to the Heart. But if the Blood

meets

meets with a greater Resistance in the Lungs, so that it cannot pass freely from the right to the left Ventricle of the Heart; then the Respiration is increased, both in Number and Magnitude, to forward its Course; and this is the Cause of Sighing and Yawning. If it be asked, Why an Animal, that is dying, may be recovered again to Life, by inflating Air into the Lungs? We answer, That the proximate Cause of Death is, too great a Resistance opposed to the Course of the Blood through the Lungs, whereby it cannot pass to the Aorta: But, by inflating the Lungs, that Resistance is removed, and the Way opened for the Blood to pass.

The Mucus, which lines the sensible Membranes of the Air Vessels in the Lungs, may become troublesome, both by its Quantity and Acrimony: It has been even known to cause Suffocation in a Dropsy of the Lungs. Therefore its Quantity, Adhesion, or Acrimony, excites a Cough; namely, an Irritation of the respirative System, by alternate large Inspirations, succeeded by large and quick Expirations, together with sudden Shocks of the abdominal Muscles; by which the Mucus, and sometimes calculous Matters, are expelled from the Lungs.

Laughing differs from Coughing in its Cause, which resides commonly in the Mind, or, at least, consists in a certain Titillation of some of the cutaneous Nerves; and, moreover, because it is made up of imperfect quick Expirations thro' the contracted Glottis, after one large or deep Inspiration: Nor is the Air perfectly evacuated from the Lungs in Laughter, which, in a moderate Degree, conduces to Health; because, to one full Inspiration, are joined many shaking Expirations, agitating the Blood. But much of it is in Danger of stagnating the Blood, because the Expiration is not full, or entire; whereby the Blood is admitted into the pul-

pulmonary Artery without being ſuffered to paſs through it. Weeping has ſhort Reſpirations like thoſe of Laughter, but finiſhes with a deep Expiration that is immediately joined by a large Inſpiration; whence it has nearly the ſame good and bad Effects; and, when moderate, it conduces to relieve the Anguiſh ariſing from Grief. Sneezing conſiſts of one large or deep Inſpiration, which is followed immediately with a powerful and ſudden Expiration.

The additional or ſecondary Uſes of Reſpiration are many*. It is by this Force that the Abdomen, with all its Viſcera, are continually compreſſed; by Virtue of this, the Stomach, Inteſtines, Gall-Bladder, Receptacle of the Chyle, Urine-Bladder, Inteſtinum Rectum, and the Womb itſelf, diſcharge their Contents; by this Action the Aliments are principally ground or diſſolved, and the Blood is urged through the ſluggiſh Veſſels of the Liver, Spleen, and Meſentery: It moreover ſerves to convey Odours thro' the Air to the Organs of Smelling. By this the Air is mixed with the Aliments, which it conduces very much to break and diſſolve, towards a perfect Digeſtion. And even Sucking, ſo neceſſary and natural to a new-born Infant, is made by the Uſe of Reſpiration; forming an ample Space in the Mouth, in which the Air is rarefied; ſo that, by the greater Preſſure of the external Air, the Milk is driven into that Part where it is leaſt reſiſted.

Laſtly, The Voice itſelf is owing to the Air which we breathe. HALLER. Prim. Lin. Phyſiol.

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* It exhales, as an Emunctory, the redundant and even noxious Particles from the Blood, which, in confined Air, ſuffocates.

END of the SECOND VOLUME.